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The Bristol Medico-Chirurgical Journal.

" Scire est nescire, nisi id me
Scire alius sciret."

JULY, 1916.

THE REDUCTION OF DISABILITIES FROM WOUNDS IN WAR.

BY

W. GORDON, M.D., F.R.C.P.,

Physician to the Royal Devon and Exeter Hospital.

THE reduction of disabilities entailed by wounds in war is a matter of national concern. Quite apart from the natural promptings of humanity, gratitude or affection, an urgent problem is presented to us carrying with it consequences of the highest national importance, military, financial and social. We have to consider, as a nation, *and soon*, by what methods of treatment we may in the fullest degree :—

(*a*) hasten the return of wounded to their units at the front, where every man is needed who can be made sufficiently fit ;

(*b*) reduce the heavy and enduring expense to the country entailed by disabilities, which timely measures may materially lessen ;

(*c*) reduce the impairment of civil industry after the

war, occasioned by the numbers of seriously and permanently crippled men.

France has set us an example in grappling with this problem by initiating a system of treatment which is proving a remarkable success. For :—

(*a*) 80 per cent. of the cases, which have undergone a complete course, are returning to their units, the duration of a " good case " being perhaps one to two months, and the average reduction of disability for all cases being 20 per cent. to 30 per cent. ;

(*b*) a remarkable financial saving has been effected for the State in pensions and gratuities by reduction of the disabilities which entail these ;

(*c*) and obviously, according to the measures of (*a*) and (*b*), the problem of impairment of civil industry is being solved in the best manner possible.

That this system is one of great value we have the most convincing evidence. The officers entrusted with its supervision are unanimous in claiming for it an efficacy in the reduction of war disabilities which no other method possesses, and their claims are substantiated by the extension of the system throughout the country. At a time when economy and efficiency are vital national needs, public authorities do not extend their undertakings for visionary advantages. The Grand Palais installation in Paris began its experiment by treating 200 patients a day, now 650 men are being daily treated in the electrical department alone ; in and round Paris other installations have been set up, and in the French Provinces there are already seven fully-equipped and satisfactory institutions of the same sort, as well as four which are less complete.

England cannot claim, so far, to have profited to any considerable extent by the initiative of her Ally in this matter. Thanks to the energy and advocacy of Dr. Fortescue Fox and

the Special Committee appointed last year by the Balneological and Climatological Section of the Royal Society of Medicine, a beginning has been made in London, by the establishment of a Physical Clinic for wounded and disabled officers. Also Major Mackenzie has been carrying out an admirable course of treatment for the N.C.O.'s and men, in the Command Depôt at Heaton Park. But, although generally throughout the country massage, electrical treatment and, in some cases, baths, and mechanical apparatus are now being employed, physical treatment *in a "combined" and systematic form* remains still to seek. This is the case, not only as regards officers, non-commissioned officers and men, but also for the large numbers of disabled men discharged from the army. The relief of the disability of the discharged soldier, although he no longer counts from the military point of view, is an economic problem of national importance.

Perhaps the appeal—surely a reasonable one—to give the Grand Palais system at least a fair trial in this country, has not yet reached those departments of the State which it most enduringly concerns. To those Government Offices which will presently have to deal with an unexampled number of war-crippled men, for whom public opinion will rightly demand adequate financial treatment, whilst it will equally rightly denounce such extra expense as might have been prevented, and to those Ministers of State who will have to grapple, after the war, with unnecessarily hampered industries, the problem of the best mode of dealing now with these disabilities can scarcely be considered negligible. Undoubtedly to the public (for the moment unaware of better or worse in the means being taken to care for our wounded) the question will ere long have to be answered—why the methods found so successful in France have not been adequately tried in England.

I will endeavour briefly to describe the system being carried out at the Grand Palais and its Annexe in Paris, as I saw it five months ago, and to outline its results. It will not, I hope, be imagined that I have left my information unreported for that great space of time.

The system (*and it must be carefully observed that it is a system, completely and regularly carried out under skilled and constant supervision*) in its essentials consists of, broadly speaking :—

(1) a preparation by heat, moist or dry ;

(2) a thorough course of massage, manipulation, mechanical treatment and electricity ;

(3) with, finally, a re-education of the affected muscles by exercises and training ;

(4) the results of the whole being checked by careful measurement of initial defect and ultimate gain.

Taking these component elements in order :—

Preparatory Heat.—I venture to doubt whether the profession at large in this country has the least idea how profoundly the results of massage may be modified by preparatory heat. My own experience leads me to attach the highest importance to it. I well remember the first case which claimed my attention many years ago. A girl with double hydrarthrosis had been put by me on back splints and Scott's dressing, with disappearance of effusion and fixation of both knees ; she was seen by an able surgeon, who advised the breaking down under an anæsthetic of the recent adhesions. Acting on other advice, I packed the knees in hot dry sand daily for twenty minutes, with manipulation, and in a week had the satisfaction of seeing their mobility completely restored. Those were recent adhesions. The following illustrates the use of hot sand on adhesions of some standing, in just the sort of case for which I am

advocating this French system. A soldier, whose arm had been torn by a shell, had rigid painful fingers which could not bear much massage or manipulation, so that little progress was being made under excellent surgical supervision. I advised baking the hand daily in hot dry sand, as a preliminary to massage and movement ; the massage became at once much less painful, the joints more supple, and progress much more rapid ; ultimately a very considerable degree of useful mobility was regained.

It cannot be too much emphasised how important it is that such treatment should be adopted early. Dr. Jean Camus, who is the responsible head of the treatment at the Grand Palais, speaks in his last report (*Le Corps de Rééducation Physique du Grand Palais*, Paris, 1916) of the " deplorable " consequences of delay. Had the second of the two cases just quoted been similarly dealt with some months earlier, directly his wounds were healed, much more could probably have been done for him. As soon as the wound is healed this system of physical therapeutics ought to be begun.

Heat is applied at the Grand Palais either dry or wet.

(i) *Dry.*—By means of *radiant light and heat*, or in other ways. Anyone who watches the effects of radiant light and heat as a preparation for massage, can testify to their great value in reducing tenderness and hastening progress.

(ii) *Wet.* — The chief means of applying this is the " *eau courante* " or " whirlpool bath " (Figs. 1 and 2),[1] described in the *Lancet* of February 5th. The *eau courante* bath consists of a simple arm, leg or foot bath, in which two or more jets of entry, turned in different directions parallel to the sides, keep the water in a constant state of rapid movement. The sensation to the immersed skin is just like that of being in rapid running water. The temperature is kept about 115° Fahrenheit, and the limb is placed in it for about twenty

[1] These figures have been kindly lent by Dr. Fortescue Fox.

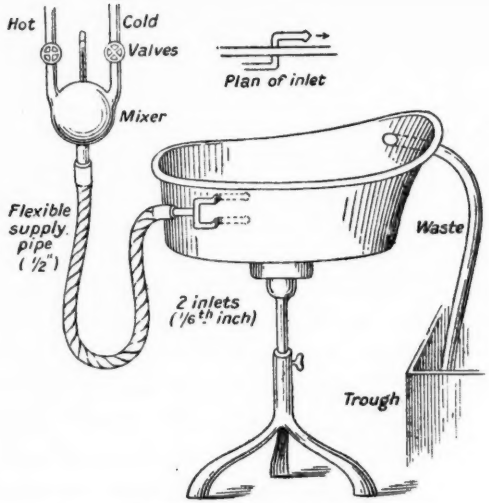

FIG. 1.—*"Whirl-pool bath" for the arm.*

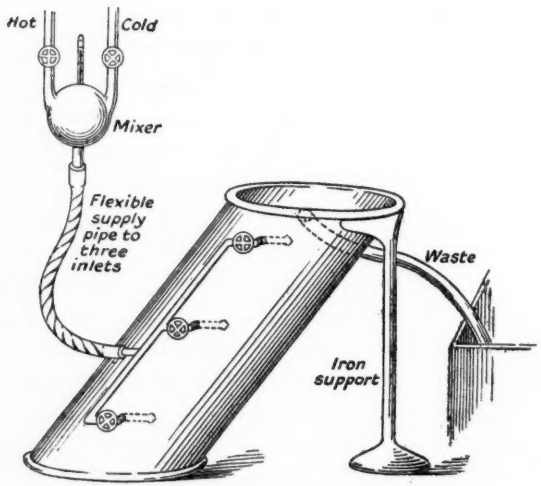

FIG. 2.—*"Whirl-pool bath" for the leg.*

minutes daily. Whatever the mode of action may be (some think a gentle surface massage is produced), those who have abundant experience assure me that, generally speaking, as a preparation for massage and manipulation, this method is unrivalled. This bath, which has been used in France for some time, is new to this country, and obviously calls for investigation. I have just said "generally speaking," because I am told that some cases do better with dry heat than with wet heat; no means apparently exist by which such cases can be identified at sight, the only way of making sure being to try both methods.

Massage and Manipulation.—No one is likely to question the need for these well-established measures. But two points will bear mention. First, massage and manipulation of painful fingers and hands can be much less painfully and much more effectually carried out actually under radiant light and heat. Second, that every month which is allowed to elapse, after the wound has healed, before these measures are adopted reduces the improvement possible.

Mechanotherapy.—The Zander method of treatment by mechanical appliances is little known in England, although one or two excellent installations exist. The principles which underlie it are:—

(*a*) That, by isolating, for treatment, just the muscles or groups of muscles which need it, and putting the others at rest, the maximum of benefit is gained with the minimum of fatigue.

(*b*) That, by means of movable weights, the desirable degree of effort can be adjusted exactly.

Incidentally the initial defect and the ultimate improvement can be precisely measured.

The instruments are "active" and "passive." With the "active" the patient uses his muscles to make the

movements. With the " passive " the movements are made for him, without any effort on his part. In using these machines it is essential that the patients should be under constant skilled supervision. It is computed that one trained nurse should be allotted to every three machines. Zander's original instruments were exceedingly expensive. Simpler instruments such as those figured in the *Lancet* of March 25th are, however, equally efficient and considerably less costly. A complete apparatus in twelve pieces has been recently designed in France for the treatment of military cases, and the first series of this kind that has reached England has been installed in the London Physical Clinic. They are very similar to those in use at the Grand Palais. The Annexe of the Grand Palais, which is used chiefly for officers, is actually the Paris Zander Institute ; it contains about seventy different instruments of the original pattern. At Enghien there is a similar installation to that at the Grand Palais. At Versailles I was shown an ingenious and inexpensive set of instruments from which good results are obtained.

Electricity seems to be used in Paris as we use it in England. It forms naturally an important part of the system.

Other methods, such as Bier's treatment, are also used when thought desirable.

Re-education of Muscles.—Great stress is laid on this last part of the system. A huge gymnasium is attached to the Grand Palais in which exercises and training of movements are carried out under the supervision of skilled instructors. Three separate corps have been constituted, viz. for upper limb, lower limb and trunk disabilities respectively. It has been found necessary in many cases actually to re-educate the damaged muscles in their restored functions.

Mensuration becomes essentially a part of any system which aims not merely at maximum reduction of disabilities,

but at fair compensation for disability acquired in the defence of the country. In France there is a regular scale of pensions and gratuities for various degrees of disability from wounds.

At the Grand Palais and other Institutions across the Channel careful measurements of defects are made on the entry of every patient, and carefully compared with the defects on exit. The difference is assessed as "gains," the financial value of which can, according to the scale used, be exactly stated. Of these "gains" I shall speak in a moment.

Detection of Malingering.—Dr. Camus has invented an ingenious instrument, whereby malingering can be detected in whatever muscles their pretended disability is seated. The tremor of the voluntary movement of the defective muscle is traced on a revolving drum, and the tracing examined. Its characters distinguish true from false.

Results at the Grand Palais.—Dr. Camus's excellent report above referred to brings the results, physical and financial, of the Grand Palais system up to the end of last February.

In six months 3,348 complete treatments have been carried out. Of this number of wounded men, 2,676 (80 per cent.) have been *cured* and sent to their depôts as fit, 457 recommended for the auxiliary services, and 215 discharged.

The reduction of incapacity for work has been carefully noted for every case. This reduction has, on the average, varied from 20 to 30 per cent.

As to the financial saving, it is calculated that the capital value of the gratuities and pensions saved by this reduction of disabilities for the month of February was as follows:—

For	Capital in francs.
486 Soldiers cured	2,916,000
81 Corporals cured	567,000
75 other N.C.O.'s cured	600,000
104 Soldiers proposed for Auxiliary Forces	416,000
12 Corporals proposed for Auxiliary Forces	56,160
14 other N.C.O.'s proposed for Auxiliary Forces	75,040
75 Soldiers recommended for discharge	300,000
9 Corporals recommended for discharge	21,240
13 other N.C.O.'s recommended for discharge	34,840
Total gains for one month ..	4,986,280

The total saving for six months (September to February) is estimated at F. 16,667,720 (at the Grand Palais alone). The rate of reduction has lately increased, and the saving at the rate attained when I saw Dr. Camus in February, if it went on—and there was no reason imaginable why it should not—would amount, he told me, to F. 50,000,000 a year, a saving so great as to render insignificant the moderate initial outlay and upkeep.

It is this *remarkable financial saving* which should commend itself to the attention of our Treasury, *whilst it is attainable*. No doubt, in our country, physical methods, however incompletely applied, have sometimes effected considerable economy. But what I would urge is that the introduction of specialised methods (particularly of baths and mechanical apparatus) and a system such as that adopted in France, would probably secure a much greater reduction of disability—a result which humanity and gratitude alone should make us anxious to achieve—and would also incidentally produce a great decrease of the burden which adequate pensions will place for years on the shoulders of the taxpayer.

The medical services of our Empire (under which title I

would include its entire medical profession) have played a part in this war of which every member of them may well be proud. One would be sorry to see them fall short of the very best, even in a single particular.

I would once more express my cordial thanks to Dr. Quiserne and Dr. Camus, the Medical Officers supervising the Annexe and the Grand Palais respectively, for the unwearying kindness which showed me, whilst I was in Paris, everything that time permitted, and for the valuable reports and illustrations which they have placed at my disposal. Also to my friend Dr. Fortescue Fox for many detailed observations and for his great help in enabling me to obtain the necessary permission from the French Government to observe the methods employed in this department of their Army Medical Work.

ON THE WORK OF A MILITARY GENERAL HOSPITAL IN EGYPT.

BY

ERNEST HEY GROVES, M.S., F.R.C.S.,

Late Major, R.A.M.C., in charge of the Surgical Division of the 21st General Hospital.

OF the many thousands of cases which passed through our hands one can speak of only a few, and for the purpose of simplicity I would confine myself to certain groups of cases.

Enteric Fever.—At one time we had many hundreds of cases of typhoid and paratyphoid. The most notable general feature about these was the mildness of the disease and the difficulty of diagnosis of the more trivial cases. Surgically there were two main points of interest. The first related to perforations. Of these we had twelve, all

of which were operated upon. In only one case was a wrong diagnosis of perforation made, and that was in an officer who was brought in in an almost moribund condition, and about whom no history was obtainable. All our twelve cases were operated upon, but we had only three recoveries. The operations, which varied in severity from mere insertion of a drainage tube into the pelvis or suturing an ulcer up to an excision of the ulcer-bearing segment of the ileus, were generally done under morphia and hyoscine and a local novocain anæsthetic. The other complication which frequently brought the enteric patient to the surgical section was involvement of the gall-bladder. This was observed in three well-marked gradations. In the first an intermittent painful swelling of the gall-bladder occurred. These all did well after drainage, and in every case a culture of the B. typhosus was obtained. Some made spontaneous recoveries without operation, and these perhaps will go to swell the army of " typhoid carriers." In the second grade a persistent tender swelling occurred in the gall-bladder region. On operation there was adhesive cholecystitis, but here again all cases operated upon made a good recovery. In the third type, fortunately the rarest, the gall-bladder actually perforated, and these all proved fatal in spite of operation.

Dysentery.—This was indeed the scourge of the Army, and delayed cases arrived in their hundreds; and many of those who died of wounds were found to have the disease in a latent condition, whilst many a man admitted to a surgical ward eventually succumbed to the more insidious disease. Three surgical points only will the limits of this article allow me to touch upon. Appendicostomy from a practical point of view proved itself to be disappointing. This I am convinced was due chiefly to the difficulty in selection of the cases. A very large proportion did well under emetine, and it seemed only right to apply this remedy to every case

for a sufficient period to give it a fair trial. At the end of the fortnight occupied by this treatment the cases which remained unrelieved were generally so very ill that no surgical treatment had any chance of success. Perforation of dysenteric ulcers was very rare; in our cases it occurred either in the transverse or sigmoid portions of the colon, and whether operated upon or not, it always proved fatal. The occurrence of hepatic abscess was, as compared with other epidemics before the use of emetine, a very rare complication. In all we had only five cases, three of which recovered and two died. In those cases which did well we were much struck by the way in which the abscess rapidly disappeared, the cavity becoming obliterated, and the operation wound healing within a fortnight. This happy result was no doubt due to early diagnosis, for which we had the invaluable assistance of Sir Ronald Ross, one of the Consulting Physicians to the Forces.

General Problems of Sepsis and its Treatment.—The wounded from Gallipoli presented the same deplorable spectacle of severe sepsis which the present war has familiarised us with. The anærobic infections, both tetanus and gas gangrene, were, however, of rare occurrence. Curiously enough, several of our cases of tetanus occurred in association with frost-bites where there had been only the most trivial breach of skin surface. But the ordinary sepsis was rampant, and every lacerated wound gave a culture of either a streptococcus, staphylococcus, bacillus pyocyaneus or bacillus coli. As regards the treatment of severely-infected wounds our experience, so far as it went, did not support the claims set forth by various authorities for the superiority of any one chemical over another.

We used (1) ordinary antiseptics, *e.g.* carbolic and perchloride, (2) peroxide of hydrogen, (3) salt solutions of various strengths, and (4) Eusol. Although each of these

methods had its advocates, I think I may fairly say that there was no recognisable difference in the results produced by each. It has to be borne in mind that we dealt only with septic conditions of seven to ten days' standing. The two things which did make for healing were free incisions of such a character as allowed the tissues to drain automatically, *e.g.* transverse incisions in dependent positions and mechanical cleaning by irrigation.

The conditions under which we worked very soon demonstrated the absurdity of trusting to a sepsis alone for prophylactic purposes. Every dressing was attended by swarms of flies, and it was much better and simpler to have towels and dressings all soaked in carbolic than to sterilise them by heat, and allow pus-soaked flies to contaminate them on every exposure.

We had a remarkable demonstration of the influence of shell fire, and soil and climatic conditions in the production of sepsis. During the winter of 1915–16 we received the wounded from the Senussi fighting. This was almost entirely an affair of rifles and machine-guns, carried on in the deserts of North Africa, and amongst these casualties it was very rare indeed ever to see a septic case, merely the clean scabbed wounds characteristic of the South African War.

In selecting certain classes of cases for special description, I am guided by what remain in my memory as those of greatest interest, importance or difficulty. Three of such there are, viz. those of wounded blood vessels, brains and bones.

Injuries of Blood Vessels.—First a few words about secondary hemorrhage. This to me will always remain as the nightmare of military surgery. It seemed to occur in kind of epidemics, and on certain days one had the feeling that, having dealt with one case, everything had to be kept

in readiness for the next. In one week we had to ligature or amputate for hemorrhage from the brachial, sub-clavian, radial, ulnar, femoral, popliteal (twice), tibial and carotid. Space will permit me to refer to only three points in this subject.

The only satisfactory way of dealing with secondary hemorrhage is freely to open up the tissues and ligature the bleeding points, being careful to secure both the distal as well as the proximal end of the severed artery. If this could be done satisfactorily, it was very rare for any further bleeding to occur.

Proximal ligature of the main artery above the wound is most thoroughly unsatisfactory. Either it is ineffectual, or else in the case of a limb it causes gangrene, and this gangrene is of a fulminating septic character, very dangerous to life. In one case (brachial) prompt amputation saved the patient's life, but in another (femoral) the patient died of septic gangrene before removal of the limb could be effected.

In one type of case the condition is very puzzling. Here the bleeding is comparatively late, about the third or fourth week, and occurs in a case which seems to have been doing well. The bleeding occurs, not from a single large artery, but oozes up from all the tissues alike. Such a hemorrhage devitalises the patient out of all proportion to the amount of blood lost, and amputation is generally out of the question. Apart from merely cleaning and packing the wound, we found one remedy which was very useful, and that was the use of a 1 in 1,000 solution of brilliant green. This seemed to have considerable properties both of astringency and penetration.

Operations upon aneurysms were among the most exciting and the most difficult that we had to perform. We had some 14 of these cases, viz. carotid 1, subclavian 2, brachial 1,

external iliac 1, femoral 3, popliteal 3, and tibial 3. It would be undesirable to go into details about these, and I will confine myself to certain general observations. The first is that it was quite exceptional to find any true aneurysmal sac, and this made any question of intra-saccular or conservative operations impossible. The next point is similar to what was said about secondary hemorrhage, viz. the futility of proximal ligature, whether done for the cure or merely as a temporary measure, preliminary to opening the aneurysm. This was especially noticeable in the subclavian cases. Ligature of the subclavian artery above the aneurysm made little or no difference, and on exposing the site of injury bleeding was terrific, and could only be finally arrested by wide exposure, digital pressure over the spouting points, and eventual ligature.

In the limbs a tourniquet above the lesion makes matters comparatively simple. It is noteworthy how very little difference the presence of a traumatic aneurysm makes to the pulse in the vessels beyond. Again and again we noted that the distal pulse was unaffected, and yet operation revealed that the main artery had been cut across. This must be due not only to the circulation going on through the open distal end of the wounded artery, but also to the efficiency of the collateral circulation, which latter circumstance also accounts for the inadequacy of a proximal ligature.

Brains.—We had the very great advantage of the presence of Sir Victor Horsley in our unit, originally as head of the surgical division and afterwards as Consulting Surgeon. His methods and the results attained by them are fully set out by Captain Whitaker in the April number of the *British Journal of Surgery*, who took over this especial work after Sir Victor ceased to be an active member of our staff.

There were 118 cases of gunshot cranial wounds, of which all but 16 involved the brain, *i.e.* were intra-dural. In 104 cases operation was performed for cleaning the wound and for the relief of intra-cranial pressure or suppuration. The mortality was 19 cases, a surprisingly low figure when the severity of the cases is taken into account.

Captain Whitaker's paper contains all the details of these cases, and I will merely refer to certain outstanding features of interest. First, it must be premised that this series represents only those who have survived seven to ten days after the injury, and takes no account of the many who must have died immediately or soon after the receipt of the wound. In such cases it was very remarkable how tolerant the brain was both to extensive injury and to virulent septic infection. Almost any degree of injury or sepsis seemed recoverable, except that streptococcal infection was generally fatal and ventricular injury always.

Nearly all cases of septic splintered cranial wounds require early operation both for the free drainage of the wound and the removal of pieces of bone. The main object of the operation is free removal of the cranial wall both for decompression and cleansing. Searching for foreign bodies is undesirable. The success of the operation depends largely on its thoroughness, combined with speed and accurate hemostasis. The latter was achieved by placing pressure forceps on all bleeding points in the scalp, and leaving these in place for twenty-four hours, and in using a bit of muslin to stop bleeding from vessels in the brain or its coverings.

There was a remarkable difference in the streptococcal and the staphylococcal infections. In the former, which were usually fatal, no adhesions occurred between the meninges and the skull to limit infective inflammation, and

the patient died of diffuse meningitis, spreading from the wound. In the latter the wound was very early shut off by meningeal adhesions, and if a fatal result occurred, this was by an infection of the ventricles, and thence by the ependyma of the basal meninges.

Curiously enough, the pyocyaneus, which is so common an organism in bone wounds of the limbs, never once made its appearance in our series of head wounds.

The dressings of the head wounds and their drainage are matters of great importance. Tubes of all sorts were avoided. The operation wound was left widely open, and covered with a perforated sheet of rubber tissue and gauze. This was changed every twelve hours, being loosened by the application of peroxide of hydrogen.

One result of the very free removal of bone fractures by Sir Victor Horsley and Captain Whitaker was seen in the spontaneous subsidence of the cerebral hernia which followed this procedure. And it should be noted that whilst bone was very freely removed, the dura was treated with the utmost conservatism consistent with removal of bits of bone or metal which had penetrated it. The dura is not the unyielding membrane that it is usually considered. After such an operation it would allow the brain beneath to swell up considerably into the wound, and then as inflammation subsided it would collapse below the surface.

Bones.—The subject of the supervision of fractures was the one which I reserved to myself, in which work I was most ably assisted by Captain T. H. Brown, who before going to Egypt was for some months resident at the Southmead section of the Second Southern General Hospital. I was allowed by the War Office to take with me a mechanic, whose work it was to make such apparatus for us as we required. Soon after the rush of work had begun, it became evident that there was a very serious shortage of splints of

all kinds throughout the Expeditionary Force. And as we had already begun to make these things for our own use, the authorities decided to extend the business so as to be able to supply hospital ships and other hospital units. A small disused fort, which had not been used except as a lumber room since the bombardment of Alexandria in 1880, was discovered on the outlying part of the hospital ground. This made an excellent factory, and with two Englishmen and twelve native workmen we were able to turn out a large quantity of splints. At first we made all sorts of stock patterns of wooden splints, but very quickly we found, both by our own experience and by the demands of others, that the light metal splints were much superior to anything else because of their cleanliness and durability. We obtained our material from the Ordnance Stores, and with mild steel, wire and flats we were able with quite simple tools to make quickly splints suitable for all gunshot fractures. The great advantage of this arrangement was that we had side by side the large hospital, in which hundreds of fracture cases were actually under treatment on the splints, and the factory where the splints were made and supplied, or where any modification could be made at a moment's notice. So that for inquirers, it was only a step from one place to the other; in the one the use of the splint was a matter of practical demonstration, and in the other it was supplied ready for use.

I do not propose to describe those types of splint which we finally evolved in any detail, as I have already done so in recent publications (*Lancet*, April 29th, *British Journal of Surgery*, April). I will content myself with certain generalisations.

A splint for a gunshot fracture must be all-metal, so as not to absorb blood and pus, or to give harbour to vermin. It should take the form of a light metal frame which outlines the limb when the latter is held in a position of physiological

rest with all its joints semi-flexed. It is prepared for application by making a cradle of strips of flannel or rubber bandage slung between the opposite bars of the frame upon which the wounded limb lies. It must provide for the maintenance of the broken limb in good position by the principle of extension of the broken bone in its long axis, so that no constricting or retentive bandage shall be necessary. Thus the wound is open for dressing or inspection as often as necessary, and the doing of the dressing in no way disturbs the fracture. The splint ought, if possible, to be self-contained, *i.e.* not dependent for its action or use upon attachment to any outside support. In military work constant moving of the patient must be the order of the day, and whether it is to the X-ray room or to the ship for home, it is of great importance to be able at a moment's notice to place the patient, splint and all, on to a stretcher without disturbing the alignment of his fracture.

I have added to this paper various illustrations taken from recent articles which will, with the attached legends, serve to show how for various conditions these requirements were carried out. And the fact that between October and March, five thousand, of these special splints were made and distributed is a satisfactory evidence of how they were appreciated.

As regards the actual results obtained in the treatment of gunshot fractures in our hospital, the difficulty arises that all the more simple cases were so quickly sent on to England that of these we can say nothing. The only group which remained with us sufficiently long to enable any statement to be made about results was that of the fractured femur. Of these we had 84, and I have given a detailed account of the first 60 of these in the *British Journal of Surgery*. A certain number were doomed to death before their arrival. These were generally those with diffuse

sepsis and septicæmia or those with involvement of the knee-joint. Others succumbed to dysentery, and others again had to submit to amputation in order to save life. There are three conditions which usually demand this procedure. First, septic injection of the knee; second, a large dirty wound which cannot be fully laid open without hemi-section of the limb; and, thirdly, secondary hemorrhage. The mortality in our cases was 10 per cent.; another 10 per cent. lost their legs; and of the remaining 80, 74 per cent. gave perfect results as far as could be judged from the period of one to three months during which they remained under our care. The remainder were cases in which either the wounds or the fracture had remained unhealed when they were sent away from us. In other words, apart from those who lost their lives or limbs, three-fourths were restored to good functional recovery. This result was obtained chiefly by employing accurate and powerful extension by means of a transfixion pin driven through the lower end of the femur or through the head of the tibia.

NOTE ON THE TECHNIQUE OF SPHENOIDAL SINUS EXPLORATION FOR MENINGOCOCCAL AND OTHER INFECTIONS.

BY

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THE recent epidemics of cerebro spinal-meningitis lend importance to the question whether the nasal accessory sinuses, and more particularly the sphenoidal sinuses and posterior ethmoidal cells, are either occasionally or frequently

the source from which the meninges become infected; in other words, provide the breeding-ground from which a local infection spreads so as to develop into cerebro-spinal meningitis. That the importance of exploration of the sphenoidal sinuses in conditions which might lead to or be caused by their infection is sometimes insufficiently recognised is perhaps due in part—

(*a*) To the erroneous assumption that the sinus is difficult of access for exploration, and

(*b*) To the belief that when infected the patient must suffer from some definite signs and symptoms that in most textbooks are described as characteristic.

One of the earliest recorded examples of meningococcal infection of the sphenoidal sinus proved in a living patient occurred in my own practice in the year 1900;[1] but the much more valuable and recent clinical research of Major Embleton and Major Peters[2] leaves no room for doubt that further attention to the sphenoidal sinus in cerebro-spinal meningitis may afford fruitful results in stamping out infection in carriers, and perhaps even in saving life. Embleton and Peters record post-mortem findings of patients dead from this disease where the sphenoidal sinuses were full of glairy pus, the mucosa so swollen and rugous as to render the ostia impervious to a probe, with osteitis of the bony walls of the sinuses and thick purulent lymph lying on the surface of the dura mater, corresponding with the sphenoidal sinus, the meningococcus being readily demonstrated both in the pus cells, in the sphenoidal sinus, and in the bone.

Lumbar puncture is regularly practised for the diagnosis of the disease, and frequently for its treatment; but surely if there is a priori reason to suspect that the sphenoidal

[1] *Diseases of the Upper Respiratory Tract*, Watson-Williams, 4th Edition, 1901, p. 366.

[2] Cerebro-spinal Fever and the Sphenoidal Sinus, *Lancet*, 1915, i. 1078.

sinuses are the source of the systemic infection in only a percentage of patients, one ought to explore also these cavities as a matter of diagnostic routine. And where these sinuses are shown to be definitely the seat of acute inflammatory swelling and exudation associated with those organisms, washing-out and drainage of the sinuses would be the natural course to adopt, unless experience showed that the procedure was unattended by favourable results. Exploration of the

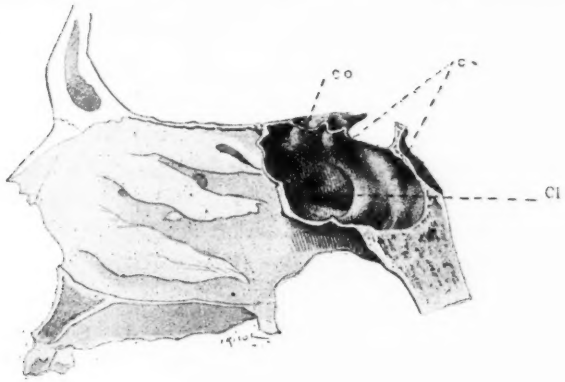

FIG. 1.

Section showing an unusually large and well-developed sphenoidal sinus which occupies almost the entire sphenoidal body and extends backwards so as to leave but a very thin plate of bone between the sinus and the foramen magnum. CO, optic canal; CI, prominence formed by the carotid canal on the outer wall of the sinus. (Sieur et Jacob.)

sphenoidal sinus naturally requires care, knowledge of regional anatomy, and some technical experience, but the same may be said of lumbar puncture.

These recent and important observations recall the earlier work of other observers, notably Westenhœffer, who also regarded the sphenoidal sinuses as the most probable route, and Netter and Debre, who favoured the view that the meningococcus entered the subarachoid space either through

the sheath of the olfactory nerve filaments as they passed through the cribriform plate or through other communications between the pia-arachnoid space and the root of the cells. It is not my intention to discuss the pathogenesis of cerebro-spinal meningitis, but to suggest the desirability of routine exploration of the sphenoidal sinuses in all cases in which the meningococcus has been found in cerebro-spinal fluid removed by lumbar puncture, and in those in which the organism has been found in the naso-pharynx and is associated with symptoms suggesting infection. It may not be out of place to emphasise the point that these sinuses may be infected by pyogenic organisms, and much mischief caused, although symptoms characteristic of sphenoidal sinusitis may be altogether absent, and even when no discharge can be seen in the nasal passages, at any rate by ordinary methods of anterior and posterior rhinoscopy. It must suffice to mention in illustration one group of this elusive latency, viz., the cases of canalicular optic neuritis with partial or even almost complete loss of vision, with negative nasal findings unless exploratory lavage and culture be employed. Now if, notwithstanding the fact that local nasal symptoms are insufficient to arrest attention, the nasal sinuses are sometimes the source of a toxic infection of the optic nerves, there is *a priori* very strong grounds for suspecting these sinuses as the breeding-ground for the meningococcus in cerebro-spinal meningitis, and this suspicion is confirmed by the references to recorded cases.

Discharges escaping from a sphenoidal sinus through the ostium sphenoidale must trickle down the external or anterior face of the anterior wall through the spheno-ethmoidal recess, and passing down between the nasal septum and posterior border of the middle turbinal on to the floor of the nose between the posterior end of the inferior turbinal body and septum nasi, thence over the back of the velum palati

to drip and be swallowed or expectorated. Unless the source of the muco-pus is confused by the co-existence of purulent discharge from the frontal sinus or maxillary antrum, its origin in the posterior group of sinuses, viz., the posterior ethmoidal cells and sphenoidal sinus, is easy to conjecture. Whether one has to do either with ethmoidal

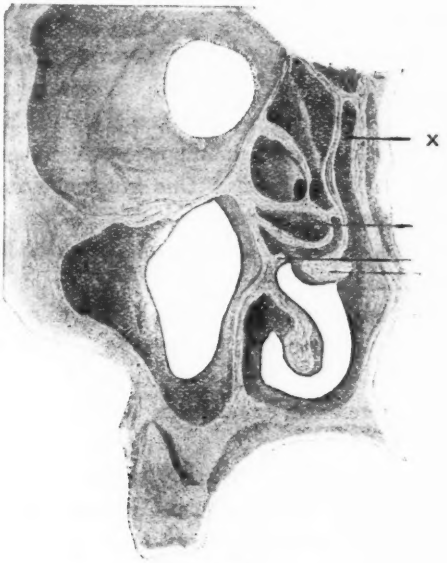

FIG. 2.

Transverse section of the right nasal passage and orbital fossa. X, the right olfactory fissure between the septum nasi and the vertical plate of the middle turbinate bone; the sphenoidal sinus ostium lies at this level a little more posteriorly. (*Shambaugh.*)

cell or sphenoidal sinus discharge, or, as is not seldom the case, a combination of both, can only be determined by direct inspection or by exclusion of sphenoidal sinus infection as the result of direct exploration.

When the mucus is abundantly mixed with polynuclears and the secretion is therefore obviously purulent or

muco-purulent, the existence of abnormal discharge is usually obvious to the patient as well as to the medical attendant. But an infection of any of the nasal sinuses, and particularly of those of the posterior group (posterior ethmoidal cells and sphenoidal sinuses) is highly elusive, and much more difficult to determine when, owing to the relative paucity of polynuclears, the discharge is almost clear and pellucid as normal mucus. Yet such cases are prone to suffer the more from toxic absorption, and are more likely to spread by various routes. Without pushing the analogy too closely, one may compare the greater likelihood of a general septic infection from post-mortem wounds which do not form a local abscess. One must not assume that patients who have no obvious purulent discharge from the nasal passages, either anteriorly or post-nasally, cannot have infected nasal sinuses.

We now come to the essential purport of this communication, which is to describe the technique of exploring the sphenoidal sinuses with a view to proving by bacteriological methods the presence or absence of the diplococcus of Weichselbaum.

The ostium sphenoidale usually varies in size from two to three millimetres in the vertical diameter, and one to two millimetres in width, sometimes more, often less, and is situated nearer the upper than the lower border of the anterior wall of the sinus. But the anterior wall of the sinus is mainly formed by the very thin sphenoidal turbinal bone, and the bony orifice is usually much larger than the actual orifice in the mucous membrane, that is to say, the anterior wall of the sinus is to an appreciable extent mucous membrane only, and the remainder for the most part only very thin and bone about one thirty-second of an inch in thickness. The median third or half of the anterior wall corresponds with the olfactory fissure and spheno-ethmoidal recess, that is to say, it is free

and faces the nasal fossa; the other half or two thirds, according to the degree of development of the sinus, corresponds with the posterior wall of the posterior ethmoidal cells. The main point is that the inner portion of the anterior wall of the sphenoidal sinus is very thin, and is directly accessible through the nasal passages. It is usually impossible to inspect the ostium sphenoidale, as it lies a little to the outer side, so as to lie behind the inward projection of the middle turbinal body. Hence in passing a probe or small mop through the sphenoidal sinus ostium, one usually has to turn the point slightly outwards as soon as it impinges on the anterior face of the sinus wall. Even with such manœuvring, and by pressing and displacing the middle turbinate outwards, or else removing its anterior end, it is impossible to find the orifice and to enter the sinus in nearly fifty per cent. of cases without causing too much discomfort.

But experience has led me to the conclusion that if one desires a cultural investigation of the sinus contents, it is usually better to pass a cannula directly through the thin wall, and then suck out any secretions that may be lying in the sinus cavity, rather than try to find the natural ostium, and this for the following reasons :—

1. It is hardly possible to pass a mop or cannula into the sinus without previously or subsequently contaminating it while passing through the narrow olfactory fissure, in which case the culture yielded may be misleading.

2. If one uses a cannula and suction syringe, and the orifice of the sinus is small, the cannula so fills the ostium that neither air nor fluid can enter or escape and no contents can be withdrawn, as there is no " bunghole."

Usually local anæsthesia suffices, and of all local anæsthetics cocaine hydrochlorate is in my experience the best, firstly because it is the most efficient local anæsthetic, and, secondly, owing to its constricting the small vessels,

and thus rendering the mucosa and the turbinal bodies anæmic. If adrenal extract is used at all, it should be a minute percentage added to the cocaine solution. The nasal passages should first be cleared by blowing the nose, or by spraying with some simple alkaline solution, *e.g.* common salt and bicarbonate of soda, so as to remove any secretions collected in the nasal passages. One fine spraying of 20 per cent. cocaine hydrochlorate aqueous solution should be made, directing it high up the nose into the olfactory fissure, and immediately making the patient lower his head, so that the solution may run out rather than backwards to the naso-pharynx. Then with a very fine absorbent wool mop wound on the end of a nasal probe, apply a little 20 to 30 per cent. cocaine solution to the anterior surface of the sphenoidal sinus, directing the cotton wool carrier high up in the olfactory fissure between the septum and the vertical plane of the middle turbinate. After two or three minutes' interval one may proceed to explore the sinus.

Exploration of the sinus may be by way of the natural ostium or by entry through the anterior wall. The patient may be seated in an ordinary chair with a head rest, or lying on the back. I prefer having the patient lying flat on his back, because it is easy to keep the head steady, and it has the effect of making the sphenoidal sinus opening uppermost, whereas if the head is erect the nozzle of the exploring cannula must dip down well below the level of the ostium before any of the sinus fluid contents can be sucked out, and not seldom this is impossible. It is quite as easy to make an inspection of the nasal passages and pass instruments with the patient lying on his back as in the more usual examination position; it is merely a question of habit and of having an adjustable lamp.

A. ENTRY THROUGH THE NATURAL OSTIUM.

Take a sterilised short silver Eustachian catheter, No. 1 size, with the distal end for three-quarters of an inch bent

downwards in a slight curve, the proximal end being of the usual size, and therefore fitting accurately the nozzle of the suction syringe. Pass the catheter under inspection by ordinary anterior rhinoscopy, using a sterile nasal speculum, and carry it upwards and backwards between the septum and anterior end of the middle turbinal, keeping close to the roof of the olfactory fissure till the nozzle impinges against the anterior sphenoidal sinus wall. Then turning the curved end slightly

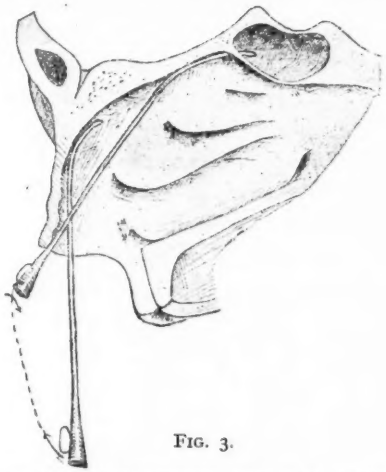

FIG. 3.

Section of the right nasal passages (outer wall), showing the method of passing a cannula or Eustachian catheter along the roof of the nasal passage till the distal end reaches the sphenoidal sinus ostium. (Sieur et Jacob.)

outwards (instead of directly downwards as it was when introduced), feel for the sphenoidal sinus ostium by gentle tapping movements until by the sensation of the resistance disappearing the cannula is felt to have entered the sinus cavity. As soon as the cannula is in the sinus, one should try to make the downward curved nozzle in its further passage backwards get downwards towards the floor of the cavity. This manœuvre is *essential* if the patient's head is erect, since otherwise the end of the catheter does not lie sufficiently

below the level of fluid in the sinus, which is determined by the position of the ostium : it is desirable with the patient on his back, as the deep part of the sinus cavity is below the level of the sella turcica.

In suggesting as above the line to try to follow for gaining access to the sinus ostium, I am aware that it cannot be done in all cases, because the anterior end of the middle turbinal body makes it impossible when it is so incurved as to approach very closely or actually impinge on the septum nasi. Yet even in such cases it is often easier to enter the probe high up above the inward curving of the turbinal than to do so from the lower level. In other cases, again, the high route is rendered impossible by anatomical conditions, and then it is usually easy to gain access to the ostium by introducing the probe or cannula below the obstruction. But in certain patients it is impossible to reach the goal either way, unless one can insert a long Killian speculum between the turbinal and the septum, and force the turbinal outwards, or, as a last resort, one may remove the obstruction afforded by the anterior end of the middle turbinate. The latter procedure should, I feel, be regarded as a *pis aller* in an exploration, first because it is rarely necessary, secondly because the nasal structures should not be removed unless absolutely necessary, and, thirdly, because if an infected sinus does exist, the less the vascular and lymphatic channels are laid open the better ; and more particularly is this the case when one suspects the existence of a meningococcus infection which is anyhow prone to gain an entrance to the pia-arachnoidal space with dangerous or even fatal result.

B. ENTRANCE THROUGH THE ANTERIOR WALL.

This is the route I have almost invariably followed, and in certainly at least a thousand sinuses the method of entry has proved easy and without any bad result. The blunt

PLATE I.

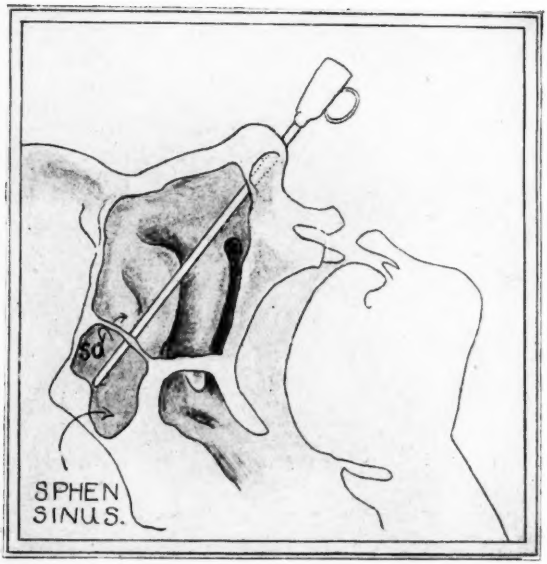

FIG. 4.

Showing Watson-Williams's sphenoidal sinus cannula passed through the thin anterior wall of the sinus so as to lie well within the sinus cavity, the "patient" lying on the back. The arrow shows the position at the normal sinus ostium, S.O.

trocar and cannula can almost invariably be insinuated between the middle turbinal body of the septum, and made to glide upwards and backwards so as to aim about one inch behind the centre of the back of the eyeball. On reaching the anterior face of the anterior sinus wall, the proximal end of the cannula should be raised to as to make it as nearly horizontal (assuming the head is erect) or as nearly vertical (assuming the patient is on his back) as possible, the distal end is gently pressed against the sinus wall, and moved slightly towards the upper or lower border of the wall, until it is felt to penetrate into the cavity, and then is gently inserted until it impinges against the posterior wall of the sinus. No force should be used, and the sensation of yielding to the slight pressure with the penetration into a cavity is so obvious that no doubt can be entertained of its being *in situ*. If it is considered possible that the cannula has passed below the sinus above the roof of the nasopharynx, one can settle the question by making a downward pressure of the canula, for if it be in the sinus, the thick bony floor of the sinus prevents such pressure displacing the distal end, while it is lying in the sinus.

Having previously drawn about 6 c.c. of sterile water into the sterilised suction syringe, the syringe nozzle is inserted carefully into the proximal end of the cannula, about 3 c.c. of the water is thrown into the sinus and at once slowly withdrawn. If the sinus contains a quantity of purulent discharge, it can be sucked into the syringe without using any water, provided the pus is not too thick; but as one cannot tell this beforehand, I always have some water in the syringe, and throw in 1 c.c. to 2 c.c., and then suck back, and then if necessary a little more, say 3 c.c., is thrown in and withdrawn. This makes it easier to withdraw any thick pus, and the pus, if present, can be seen as a turbid stream or sometimes as a coherent

cord, like a piece of string or wool, running into the column of water in the syringe.

But if no pus can be seen in the fluid withdrawn from the sinus, but only a slight turbidity, it must not be assumed that the contents are healthy, the fluid should then be ejected from the syringe into a sterile bottle and submitted to bacteriological investigation. On the other hand, one must not assume that a little turbid mucus withdrawn from a sphenoidal sinus is conclusive evidence of its being infected or the seat of disease.

As a further precaution of practical value, the nozzle of the exploring cannula should not be in actual contact with the sinus wall during the suction process, as the mucous membrane may so hermetically seal the aperture that no suction of fluid is possible, and either nothing can be drawn back into the syringe, or only blood from the injured mucosa. To avoid this, having felt the nozzle impinge on the posterior wall of the sinus, one should withdraw it about one-eighth of an inch before making attempts to suck up the sinus contents.

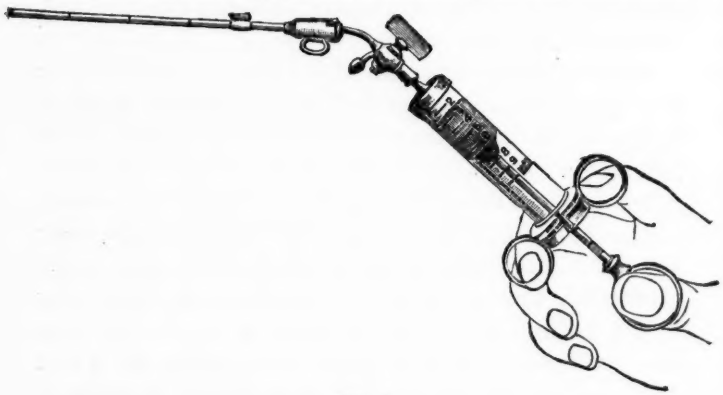

FIG. 5.

The author's exploring syringe with the sphenoidal sinus cannula attached. The two-way stop-cock shown in the diagram is now discarded, the nozzle of the syringe being attached directly to the cannula.

It is quite possible in many cases to tell that the sphenoidal sinus mucous membrane is not healthy simply from the sensation of velvety thickening of the mucosa, which the impact of the cannula against the posterior sinus wall yields, instead of the feeling of coming against a bone covered with gold beater's skin, which is the normal sensation imparted. Moreover, the sphenoidal sinus lining mucosa may be more than velvety in the degree of thickening, it is fairly often distinctly œdematous, and occasionally polypoid; with such conditions it may be difficult or even impossible to withdraw fluid contents from the sinus, for although one can inject the water, as soon as one exerts any suction the œdematous mucous membrane tends to come against and seal the lumen of the cannula. The cavity of the sinus, too, may be so encroached on by an extremely swollen mucous membrane that there is little or no space for secretions to collect.

The fluid having been successfully collected, it should be examined (*a*) by staining films, (*b*) by culture.

The film examination allows cytological observations, and on staining the organisms present may be recognised, and any degree of phagocytosis noted.

If organisms are found in such quantity as to leave no doubt of the sinus under question being a seat of infection, the proper course is to open the sinuses by removing a considerable part of the anterior wall, so that free drainage is ensured and frequent lavage of the cavity becomes an easy matter. The method of opening and treating the sphenoidal sinus is outside the scope of this communication, and can only be undertaken with safety by those who have had special training in the operative treatment of the nasal passages.

Without attempting to discuss all the various symptoms and signs of a sphenoidal sinus infection, I would like to direct attention to the great value of the relatively new method

of endo-rhinoscopy, more particularly in the diagnosis of sphenoidal sinus affections. The endo-rhinoscope is practically a periscope similar to a cystoscope, of a length and diameter suited to its use in the nasal passages. By ordinary anterior rhinoscopy it is very rarely possible to see this sphenoidal sinus ostium or the face of the anterior wall of the sinus in which it is situated, and one can never see the sphenoethmoidal fissure, and therefore one has hitherto depended on posterior rhinoscopy and the appearance of discharge coming down the choanæ narium above the posterior end of the middle turbinate. Now it is difficult to catch the discharge in that position, even when it comes down in sufficient quantity to be visible there; but although it is possible to see the pus in that position, one has still to surmise that what is seen must have come from the posterior group of cells, valuable as that may be as far as it goes. But with the endo-rhinoscope one can get a direct view of all the region, and look at the Eustachian tubes and above them into the sphenoethmoidal recess, observing strings or small blobs and fibres of muco-pus that by any other means would altogether escape notice. One great advantage of endo-rhinoscopy lies in the ease with which one can make direct inspection in a patient who is too ill to be examined by posterior rhinoscopy, or one has only to pass the instrument along the floor of the nasal passages until the posterior border of the vomer comes into view, and then rotate it gradually so as to bring the various parts under inspection. This can be done as the patient lies on his back in bed as easily as in the sitting posture, and in an unconscious or semi-conscious patient in whom any other method of inspection is either impossible or highly unsatisfactory. But owing to the nature of the infection it is essential to wear an efficient nose and mouth mask in cases suspected of cerebo-spinal meningitis.

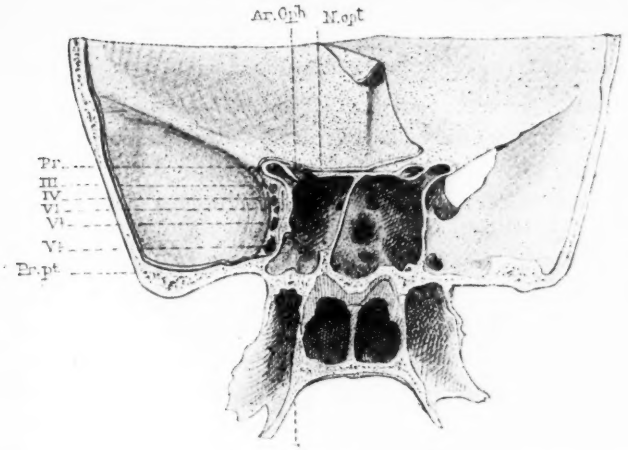

FIG. 6.

Transverse section through the sphenoidal sinuses. The dividing septum is displaced to the left, the right sinus bein -large, and it would be possible to enter this sphenoidal sinus through either nasal passage N.opt, optic nerve ; Pr, prolongation of the sinus into the anterior clinoid process and lesser wing ; III, IV, VI, third, fourth and sixth nerves ; V^1 and V^2, the first and second branches of the Vth nerve. (Sieur et Jacob.)

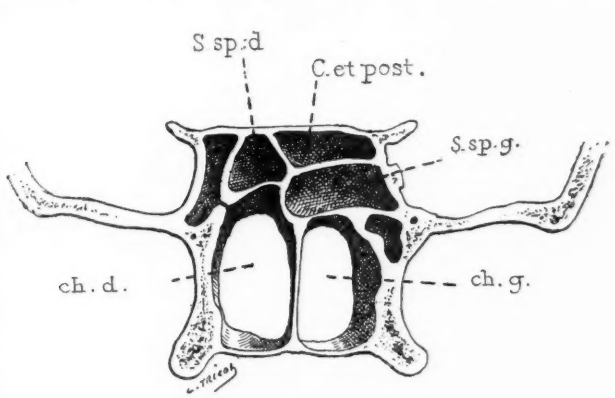

FIG. 7.

Transverse section of the nasal passages through the sphenoidal sinuses. In this preparation the right sphenoidal sinus (S.sp.d.) and the left (S.sp.g.) are irregularly developed, and especially on the left side the posterior ethmoidal cells are extending backwards and encroaching on the space usually occupied by the sphenoidal sinus (Sieur et Jacob.)

A further point that it may be worthy to note here is the fact that a headache due to sphenoidal sinusitis is rarely located at the seat of origin. Headache is frequently absent, and when present is usually located at the back of the eye-ball, and not seldom is either supra-orbital, suggestive of a frontal sinus affection, or in the ear of the corresponding side where it may be so severe that the patient is convinced that he has an abscess there. The difficulty in determining the existence or otherwise of infective sphenoidal sinusitis in its early stage is often very considerable, and may remain for some time in doubt, unless one resorts to the clinching test of exploration and culture; and more particularly is it desirable that in cerebro-spinal meningitis the suspicion should be cleared up before the progress of the disease has rendered such information useless to the patient.

I find that during the first half of the year I have explored fifty-one sphenoidal sinuses in my private practice, besides a considerable number at my hospital clinic, but of these fifty-one sinuses twenty were bilateral explorations. Operation on the sphenoidal sinuses in the majority of cases so explored was not performed as the results of exploration, were negative or too indefinite to justify it. Many of the explorations were carried out under general anæsthesia for operations on other sinuses that were known to be diseased, or on the septum, and a considerable proportion were done under simple cocaine anæsthesia. The latter were sometimes described by the patient as distinctly painful, though in no case did they complain much or show signs of pain at the time, nor did pain continue after the procedure was completed, the worst feature being in a few patients a slight headache lasting an hour or two.

MEASUREMENTS.

The distance between the point of entrance to the nasal passages and the anterior and posterior walls of sphenoidal

sinus vary considerably, and more especially so as regards the posterior wall. One's approach to the sphenoidal sinus is along an oblique line, and the face of the anterior sphenoidal sinus wall is also oblique, hence the measurement in any given case depends to some extent whether one strikes the sinus in its upper or lower part. This variation is greater when one comes to the posterior wall, because a straight cannula passing through the natural ostium or through the upper portion of the anterior wall usually comes up against the wall of the sella turcica, that is the shallow part of the sinus, whereas in passing through the lower half of the anterior wall one enters the deeper part of the sinus. One can usually reach the deeper part of the sinus even with a cannula entering through the upper part of the anterior sinus wall, (*a*) either by using a cannula with a downward curve or (*b*) by raising the proximal end of the straight cannula till the entering instrument is as nearly horizontal as the nose permits, taking care to keep the distal end steady and unshifting from the point where it rests against the anterior sinus wall. The latter manœuvre anyhow has a double advantage ; firstly, it carries one into the deep part of the sinus, and secondly, after entering the sinus one comes up against the thicker part of the posterior sinus wall instead of the relatively thin anterior wall of the sella turcica or perhaps the roof. Anyhow, it is wise not only to keep the cannula as horizontal as one can, but also to keep along the side of the septum and not direct the blunt end of the exploring cannula outwards, where it might come against the outer wall, and where careless manipulation and any unnecessary force might injure the cavernous sinus wall or even the optic nerve.

I usually make my measurements from the tip of the patient's nose to the anterior wall and to the posterior wall of the sinus, the difference giving one the depth of the sinus.

I have made a large number of measurements from the anterior surface of the upper tip at its junction with the lower margin of the naris, but this is less convenient.

Taking a few cases at random, I find the measurements are :—

Adults.	*Nose tip to anterior wall.*	*Nose tip to posterior wall.*
Male	—	R. $3\frac{3}{4}$, L. $3\frac{1}{2}$.
Male	—	R. $3\frac{1}{4}$.
Male	—	R. $3\frac{7}{8}$, L. $3\frac{5}{8}$.
Male	R. $3\frac{1}{3}$, L. $3\frac{1}{3}$.	R. 4, L. $4\frac{1}{8}$.
Female	R. $3\frac{1}{8}$, L. $3\frac{1}{8}$.	R. $3\frac{7}{8}$, L. $3\frac{7}{8}$.
Female	—	R. $3\frac{7}{8}$, L. 4.
Female	—	L. $3\frac{1}{8}$.
Female	—	R. $3\frac{1}{2}$, L. $3\frac{1}{2}$.
Female	—	R. $3\frac{1}{2}$, L. $3\frac{2}{5}$.
Female	—	R. $3\frac{7}{8}$, L. 4.
Female	$2\frac{7}{8}$.	$3\frac{1}{8}$.

In a girl aged $14\frac{1}{2}$ years the distance was $2\frac{1}{2}$ inches to the anterior wall R. and L., and to the posterior wall R. $3\frac{1}{3}$, L. $3\frac{1}{2}$.

Others give measurements as follows :—

Rosenberg, [1] from the anterior naris to the anterior sinus wall .. .. 6 to 8 cm.

Laurent, [2] from the anterior nasal spine to the anterior sinus wall .. .. $6\frac{1}{2}$ cm.

Sieur et Jacob, [3] from the anterior nasal spine to the anterior nasal wall .. .. 7 to 8 cm.

I prefer to rely on my own above-mentioned observations, as they are without exception those obtained clinically. But these measurements must not be taken as giving the real depth of the sinuses between the anterior and posterior walls,

[1] Soc. de Laryng. de Berlin, 1894, cited by Sieur et Jacob.

[2] Reunion anuuelle des Otolaryngologistes belges, June, 1894, cited by Sieur et Jacob.

[3] *Fosses Nasales*, p. 346.

such as one could get from the same subjects if they were measured in sagittal section in anatomical specimens, the "errors" being due to the causes previously described.

EXPERIENCES OF AN EAR, NOSE AND THROAT SPECIALIST AT ONE OF THE BASES.

BY

CAPTAIN J. P. I. HARTY, R.A.M.C.T., F.R.C.S.

OUR work here is arranged on practically the same principles as those of a civil clinic. We have the out-patient system, which was sanctioned by the D.D.M.S. owing to the number of cases attending for consultation from the various hospitals, while those from the base depôts, etc., receive daily treatment in addition where necessary.

We have a special hut set apart for the out-patient department. This is divided into a waiting-room capable of holding 80 to 100, and an examination room screened off so that two officers can work there, and also a dark room for trans-illumination.

Captain Just came to assist me about a month after my arrival, and even with his help the work is as much as we can accomplish.

Our largest number of new cases in one day was 52, and the number attending for daily treatment at one time averaged 120. We found it necessary to reserve one day a week for operations, seeing no new cases on that day, the daily attendances only receiving treatment.

The appended statistics are compiled for the period January 1st to May 15th, 1916, inclusive.

1. Full list of cases, their diagnosis and disposal.
2. List of operations.

One great advantage which we have is that the treatment is administered daily by skilled hands, and not left to the patients themselves. This is especially valuable in the treatment of one of the biggest leakages of the army, viz. middle-ear suppuration, and we have found that in suitable cases these dry up soon, and we are able to return to duty a large number of men who were previously being sent to England.

We have been very lucky in obtaining the assistance of a most capable sister, and one who takes an interest in the work.[1]

I was fortunate enough to obtain printed cards with diagrams modelled on the same principle as those used at the Bristol Royal Infirmary, and these have minimised our work, and made the records of the cases complete and concise. Comparing the statistics with those of a civilian clinic the differences are not great.

We have an almost complete absence of malignant cases and a very small percentage of tuberculous. This discrepancy is only to be expected on account of the age limit and the chest examination on enlistment. Sinusitis is a little less frequent, and this can be accounted for by the fact that we are working with males. I can say without hesitation that it is not a case of missing them, as in every case a complete examination of the nose and nasopharynx is made, and on any indication a sinus exploration is undertaken and skiagrams consulted in the case of suspected frontal sinusitis.

The war casualties which appear amongst our statistics comprise the following :—

A. Gunshot wounds of the face, jaws and ears.

B. Results of shell concussion on the middle internal and external ears.

C. The neurasthenic complication functional aphonia, which is fairly common.

We have a great preponderance of cases of middle-ear suppuration, possibly due to the difficulty in eliminating such cases at the medical examination for enlistment, as fully 50 per cent. of those examined with this complaint have had it when they joined.

It may be of interest to summarise our experience of the results of shell concussion on the ears. They may be divided into the following groups :—

1. *Otitis externa without implication of the middle ear.*

The percentage of these cases is hard to estimate, but undoubtedly some are due to this cause.

2. *Rupture of the membrana tympani.*

Of these three sub-groups may be mentioned :—

(*a*) Perforation without infection of the middle ear.

(*b*) Perforation with infection.

(*c*) Perforation complicated with nerve deafness.

With regard to the rupture, we have found that practically the pathognomic form is the kidney shape, with the apex of the handle of the malleus at the hilum.

In one case I have seen two perforations, the smaller one being situated in the postero-superior quadrant, and rather indicating it to have been due to direct violence, some small foreign body having been driven through as a result of the explosion. The larger one was of the type described above.

Infection is, as would be expected, fairly common owing to the fact that particles of dirt are carried in either from outside or from the meatus, which under war conditions is anything but aseptic. Nerve deafness is uncommon with perforation, the simple explanation being that the concussing force is taken by the membrane and its rupture saves the internal ear in most cases.

It is possible that in the perforation cases there is a

rapid reflex action of the tensor tympani tightening the membrane, and the brunt of the concussion is borne in this way. It has been, however, our experience that nerve deafness without perforation is often associated with an atrophic condition of the membrana tympani.

3. *Nerve deafness.*

This has been classified into two sub-groups :—

(*a*) Auditory concussion.

(*b*) Labyrinthine hemorrhage.

We have not had the opportunity of investigating these, as the main differences seem to be that the former will at all events partially recover after some months, while the latter is permanent.

4. *Nerve deafness superimposed upon ears, either in a state of chronic suppuration, or with dried-up perforations, the results of earlier suppuration.*

We have had a fair number of these, and in the absence of the protecting influence of the membrane the internal ear naturally suffers.

5. *Subluxation of the stapes.*

Two instances of the above have come under our notice where there was a markedly indrawn membrane on one side with a negative Rinne, and a normal bone conduction combined with a clear history of concussion. A single inflation by means of the Eustachian catheter cured these, a positive Rinne and perfect hearing resulting.

Subjoined here are the statistics of these cases :—

Shell Concussion Effects on the Middle and Internal Ears.

Nerve deafness	31
Concussion perforation *without* infection ..	3
Concussion perforation *with* infection	15
Concussion perforation *without* infection combined with nerve deafness[1]	5

[1] Subluxation on the left side and perforation with nerve deafness on the right included in the above.

Concussion perforation *with* infection combined with nerve deafness	8
Concussion nerve deafness superimposed on old chronic suppurative otitis media	10
Subluxation of the stapes	1
	83

Included in the above are two rather interesting cases illustrating these types.

Two men came up together. On examining the first, he was found to have the characteristic perforations in both ears, non-infected and without any nerve involvement. His history was that a trench mortar had burst near him five days previously. The second man was standing near the first, but he was buried by the explosion, and had to be dug out. Just when he was free another trench mortar exploded and buried him a second time, and sad to relate on extricating himself a third burst quite close. This man on the right side had a characteristic concussion perforation, evidently produced by the first explosion, and a pronounced nerve deafness superimposed by the later explosions. On his left side he had escaped with a negligible amount of nerve involvement and a subluxation of the stapes cured by inflation.

With regard to the sinusitis cases, our explorations of the maxillary and sphenoidal sinuses have been made by the suction syringe method of Watson-Williams, which has proved reliable. The actual number of explorations made has been :—

	Sinus.	*Positive Result.*	*Negative Result.*
75	Maxillary antra	32	43
13	Sphenoidal	5	8

Sinus operations have been performed where thought advisable, and if necessary the cases transferred to England

for a continuance of treatment, but a fair number have been returned to duty, cured, direct from here. The intranasal operations have been performed in all cases with one exception, a frontal sinus seen in the late stage where the anterior wall had necrosed and osteomyelitis of the frontal bone had already started. This was treated by the external method with obliteration of the sinus, but unfortunately proved fatal owing to rapid extension of the osteomyelitis with infection of the meninges, etc.

The endonasal method of Watson-Williams has been used for entering the frontal sinus, and our results have been very satisfactory, enabling us to return some cases to duty after a short period of daily washings out.

The statistics show a large number of operations performed for nasal obstruction, especially those due to septal deflections. In this war clear nasal passages are absolutely essential, as when a man is wearing his gas helmet he is solely dependent on his nasal respiration. The history most frequently is that the man is unable to wear the gas helmet, or when he has it on that he is incapable of performing any active movement.

I am including short notes on a few cases which I think might be of interest.

Case 1.—Sergt. G. W. This man complained of pain in the left ear, especially after being on the rifle range. On examination he was found to have a small scar just in front of the left tragus, which he said was due to the removal of an accessory auricle in childhood. Otoscopy revealed a small horn-like ecchondrosis growing from the anterior meatal wall which curved inwards and almost touched the membrane. A patch of hemorrhage was seen on the membrane at what must have been the point of contact during any excessive excursion of the conducting mechanism.

The ecchondrosis was successfully removed by the meatal route and the man returned to duty.

Case 2.—Lance-Corpl. M. Admitted here May 1st. On April 25th a trench mortar burst close to him, and a fragment was driven through the left side of the bridge of his nose, fracturing

FIG. 1, CASE 2.—*Lateral skiagram. Nose to right.*

FIG. 2, CASE 2.—*Antero-posterior skiagram showing the shrapnel fragment in the right sphenoido-pituitary region.*

the left nasal bone and making a distinct window. His mental condition was good, but he was suffering from a ptosis of the right eye, and on more careful examination he was found to have right-sided complete ophthalmoplegia with anæsthesia over the distribution of the frontal nerve. Skiagram, prints of which are attached, showed the irregular shaped foreign body to be situated in the region of the pituitary fossa. On May 4th, under general anæsthesia and using Killian's long speculum, the missile was found to have tracked across the nose perforating the upper portion of the septum; it then passed through the right sphenoidal sinus, and the foreign body could be seen through a hole in the posterior wall of the sinus. Attempts to remove it with forceps and also with the magnet were unsuccessful. May 5th another attempt was made, and this time the aperture in the posterior sinus wall was carefully enlarged, and a right-angle seeker passed so as to curve behind the foreign body, which was thus dislodged, and after some difficulty, owing to the depth, seized with a pair of nasal packing forceps and extracted. The dura mater on careful inspection seemed to be intact. The cavity was swabbed out with collosol argentum, and subsequently spraying with the same fluid frequently employed. The patient, although never feeling very bad, said he was much better, and a slight headache he had previously disappeared.

Captain Pringle examined the eye condition for me, and agreed with the ophthalmoplegia diagnosis. The fracture had evidently run into the sphenoidal fissure and implicated all the nerves. He still had at this later date, May 22nd, almost complete loss of all ocular movements.

Paralysis of accommodation with a dilated pupil.

Ptosis.

The vision is not impaired beyond what can be accounted for by the loss of accommodation.

Visual fields full.

Discs normal.

Vessels normal.

The slight movement of the globe is due to the external rectus. Whether this indicates the initial stage of recovery starting in the sixth nerve time alone will show, but Captain Pringle thinks the prognosis is bad.

The patient has been able to get about for some days, and on May 22nd I freshened up the edges and brought them together, closing the entrance wound.

Case 8.—Private B. Shrapnel ball in right maxillary antrum. This man was seen on January 28th. He was wounded on January 10th, the ball entering the right orbit. Enucleation of the globe was performed on January 11th at

the C.C.S. Admitted here February 7th. The skiagram shows clearly the size and position of the ball. Rhinoscopy revealed a perfectly clean and roomy right nasal cavity, but no sign of the foreign body.

After careful localisation by stereoscopic radiology, operation was undertaken on February 13th. Under general anæsthesia an intranasal entrance to the antrum was made, and a little finger introduced could feel the foreign body partially fixed in the roof. It was easily dislodged, but owing to its size extraction was difficult, so the patient was taken into the X-ray room, and a forceps having been passed in, with the help of the screen it was an easy matter to seize the ball and extract it, although the combined girth necessitated a strong pull when passing through the anterior naris. Recovery was very rapid, no temperature, and the antrum perfectly clean after a few washings out. The patient was sent to England on February 18th. Skiagram print attached.

Case 4.—Private M. This case, unfortunately, had a fatal termination. Admitted here April 30th.

History.—On April 27th he was struck by a rifle bullet in the left infraorbital region. His eye was removed at the C.C.S. He came down with a tube inserted along the track of the bullet. The tube was taken out and a glycerine and saline

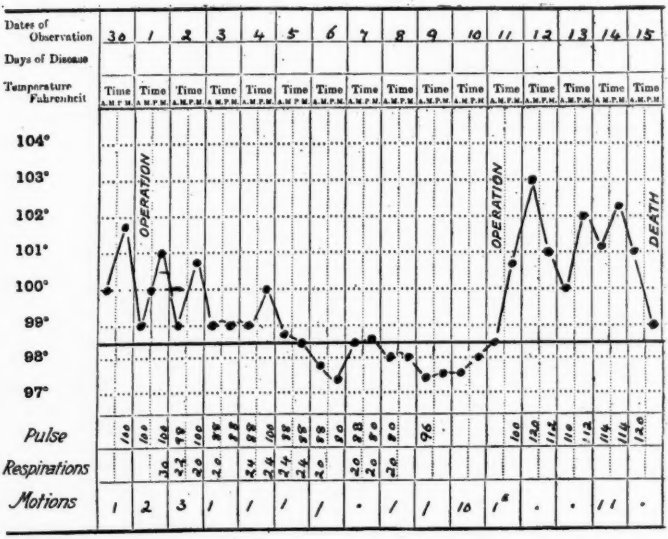

FIG. 1, CASE 3.—*Shrapnel ball in the right maxillary antrum.*

FIG. 2, CASE 4 (Private M.).—*Showing the bullet case on the arch of the atlas, etc.*

dressing applied. The attached skiagram speaks for itself. The projectile had travelled almost horizontally backwards and to the right, and all the small shadows represent portions of the interior of the bullet, the main shadow resting on the right side of the arch of the atlas being the distorted case.

May 1st. Operation under a general anæsthetic. An attempt was made to remove the foreign body through the mouth via the isthmus pharyngei; this was unsuccessful. Right and left intranasal antral operations were then performed. The antra were washed out that evening, and subsequently twice daily. The mouth was sprayed frequently with collosol argentum, and the nasopharynx on the right side where the finger could feel comminution in the pterygoid region was also washed out twice daily with a solution of collosol argentum in normal saline (1 in 3) by means of a Eustachian Catheter.

The patient's condition rapidly improved, as the temperature chart shows, and on May 7th the fluid on washing out ceased to emerge from the infraorbital wound, which was quite healed on May 10th. On May 11th, under general anæsthesia, an incision was made behind the sternomastoid which was retracted forwards with the vessels, and then by working upwards the foreign body, found to be a distorted bullet case, was eventually removed with great difficulty. Major Tabuteau assisted me, and eventually was responsible for the extraction.

Unfortunately, infection of the most virulent type ensued, spreading amongst the deep tissues and under the prevertebral fascia, with a resulting mediastinitis and death on May 15th.

TOTAL LIST OF CASES.

	Total List.	Disposal.					
		Returned to duty.	Sent England.	Fit for Base duty.	Attending at the time.	In Wards.	Deaths.
NOSE.							
Sinusitis.—Frontal	4	2	1	—	—	—	1
Maxillary	28	5	17	—	—	6	—
Sphenoidal	2	—	1	—	—	—	1
Frontal and Maxillary	4	—	3	—	—	1	—
Pansinusitis	6	—	6	—	—	—	—
Polypi and Ethmoiditis	9	4	5	—	—	—	—
Deflected Septum	88	62	15	1	3	7	—
Hypertrophic Rhinitis	57	45	2	—	8	2	—
Atrophic Rhinitis	12	—	9	2	1	—	—
Congenital Syphilis	2	—	2	—	—	—	—

TOTAL LIST OF CASES (*continued.*)

	Total List.	Disposal.					
		Returned to duty.	Sent England.	Fit for Base duty.	Attending at the time.	In Wards.	Deaths.
LARYNX AND PHARYNX.							
Pharyngitis	20	15	—	—	5	—	—
Acute Laryngitis	93	69	16	—	7	1	—
Chronic Laryngitis Papilloma	2	—	2	—	—	—	—
Tuberculous	2	—	2	—	—	—	—
Specific	2	—	2	—	—	—	—
Simple	12	5	6	1	—	—	—
Post-Cricorid Malignant Growth	1	—	1	—	—	—	—
Neurosis	2	2	—	—	—	—	—
Functional Aphonia	21	11	8	—	2	—	—
Tonsillitis and T.'s and A.'s	101	77	3	—	7	14	—
Syphilis of Nose, Pharynx and Larynx	6	—	6	—	—	—	—
EARS.							
Cerumen	53	49	—	—	4	—	—
Otitis Externa	122	88	7	—	22	5	—
Chronic Catarrhal Otitis Media	253	161	26	38	24	4	—
Acute Suppurative Otitis Media	48	29	10	—	6	3	—
Acute Catarrhal Otitis Media	30	21	—	—	9	—	—
Chronic Suppurative Otitis Media	689	231	314	50	78	13	3
Old Radical Mastoid Cases	18	6	9	3	—	—	—
Otosclerosis	9	—	9	—	—	—	—
Nerve Deafness	12	—	7	5	—	—	—
Labyrinthine Deafness post Cerebro-Spinal Fever	1	—	1	—	—	—	—
G.S.W.							
Concussion, Nerve Deafness, Perforations, etc.	86	23	46	10	7	—	—
Stenosed External Auditory Meati	2	—	2	—	—	—	—
Maxillary Antra, etc.	18	5	6	—	2	4	1
Unclassified	75	64	8	—	3	—	—
	1890	974	552	110	188	60	6

OPERATIONS.

Tonsil enucleations and adenoid removal ..	74
Minor operations	62
Submucous resections	64
Intranasal maxillary antral operations ..	16
Intranasal frontal sinus operations	7
External frontal nasal operations	1
Removal of ecchondrosis of external auditory meatus	1
Removal of foreign body from pituitary fossa (two operations)	2
Mastoid incomplete operation	4
Mastoid incomplete operation combined with obliteration of lateral sinus, etc.	1
Operation for stenosed external auditory meatus	2
	234

SOME NEUROSES OF THE WAR.

BY

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THE following observations are based on cases seen in the Neurological Department of the 2nd Southern General Hospital. I propose to deal with the clinical aspect of the various neuroses met with amongst soldiers in this war. The majority are due to more than one factor. Some of the causes are psychical—terror, noise, the horrifying sights and experiences of the trenches—others physical; apart from

actual wounds, the concussion of the air due to high explosives, burial in a trench, respiration of noxious gases, especially CO, as Dr. Mott has shown, more or fewer of which have been at work in individual cases of the condition known as shell-shock.

In many of the affections here considered it might justly be asked in what sense the term neurosis is used. According to Gould, a neurosis is an abnormal nervous action or an affection of the nerves or nerve-centres of a functional nature. I think we shall be on firm ground for clinical purposes if we exclude all cases which present any one or more of the definite clinical signs which we have learnt to associate with structural change in the central nervous system. At any rate, if we take this as a working hypothesis, we shall not go far astray. That the present conceptions of what constitutes a functional, as apart from an organic lesion, may require modification is quite likely, and only to be expected from the lines on which neurological investigation has hitherto proceeded. The distinction cannot be based upon the presence or absence of an external lesion, for it has been shown by Gordon Holmes, Mott and others that the effect of high explosives may be to produce organic lesions of the central nervous system, sometimes intense and localised, at others wide-spread and of slight intensity, in the absence of any sign of external injury. But in such cases, always in the former and generally in the latter, there will be clinically the accepted signs of organic disease, *i.e.* of structural changes. It seems to me, however, possible that minute multiple lesions of the central nervous system, especially if wide-spread, may, though the damage from any one of them is negligible, through a massed effect give rise to symptoms or signs not recognisable by present clinical methods of investigation as due to an organic lesion, but rather to those of functional disturbance or neurosis.

Further, that there would be all grades of such affections from what seemed to be a pure neurosis at one end leading through more doubtful cases to those at the other end, with undoubted signs of structural changes.

The neuroses of war will be partly due to the same causes as in civil life, and partly to other and special causes. It is to be expected, therefore, that we should meet with the familiar neuroses of civil practice, and also with other conditions presenting unfamiliar or special features. This may be made the basis of a preliminary classification.

Amongst the former will be easily separated the cases of hysteria, because the signs of this particular neurosis are well known and easy of recognition. Most of them are quickly cured by accepted methods when their nature is recognised. Cases of recent origin are more amenable to treatment than those of long standing, hence one importance of prompt recognition. If we take these cases first, we find that they comprise the ordinary manifestations of hysteria, viz. monoplegias, paraplegias and hemiplegias, with or sometimes without the pathognomonic sensory disorders and muscular contractures, affections of the special senses, such as deafness or amaurosis, and of special nervous mechanisms such as speech, and of anorexia or vomiting.

When hysterical paralysis of one limb is caused by a wound, the wound may be superficial or deep, slight or severe, the paralysis may come on at once after the injury, or not for some considerable time. The position of the wound is sometimes an aid to diagnosis, for it may be so situated that it could not by injury to nerves produce the paralysis present. Most commonly the paralysed parts are distal to the injury, or do not extend farther centrally than the position of the wound. There is generally anæsthesia of the well-known hysterical type, that is to say, covering an area like a glove or sleeve in the upper and like a stocking

or sock in the lower limb or the whole limb may be anæsthetic as far as the shoulder or the groin. The upper limit of the anæsthesia is transverse to the long axis of the limb, as a rule is sharply defined, and the boundaries of the loss of the different forms of sensation are coterminous. All forms of sensation may be lost together, but those to light touch and pain (pin-prick), are more frequently affected than to heat or cold. Sensation to either hot or cold may be preserved and the other lost, or cold felt as warm. So that certain forms of dissociation of sensation are sometimes met with, and these anomalies may vary over different parts of the anæsthetic area. Attention to the distribution and characters of the anæsthesia rarely leaves any doubt as to its true nature. The affected limb is often cold, bluish-red, and sometimes slightly adematous, (œdeme bleu of Charcot).

The above points may be illustrated by two cases. In the first there was a bullet wound of the forearm just below the elbow; paralysis of all movements of the forearm and hand came on shortly after the injury. When examined six weeks later there was general loss of movement of forearm and hand, without muscular wasting or alteration of electrical reactions. The hand was blue and cold. There was "long glove anæsthesia," its upper limit ending sharply at the level of the wound. Under treatment recovery was complete in a fortnight.

The second case was wounded slightly in the shoulder on 12th March. There was no paralysis at first, but in May he began to lose power in the hand, and this gradually increased until the hand became completely paralysed. He did not come under my observation until December, when he had had complete paralysis of the hand, of the long flexors and extensors of the fingers, as well as of the small muscles, for some months. Efforts to move the hand resulted in violent contraction of the arm muscles. There was no

wasting during this long time, and electrical reactions were normal. Over the hand and to about four inches above the wrist there was complete loss of all forms of sensation, including those of pressure, sense of position and movement, and cold, however, was felt as warm. He also made a rapid and complete recovery.

The cause need not be a wound. Just as occurs in civil practice, any injury may produce hysterical monoplegia. Thus a man came under treatment for paralysis of the leg and foot after a Pott's fracture. There was "stocking anæsthesia" except on the sole of the foot, which was hyper-æsthetic. In other cases the cause appeared to be exposure to cold and wet. One patient was at first paraplegic, then the left leg recovered, leaving the right paralysed. This illustrates another feature of some of these cases in which an originally extensive paralysis leaves a more limited one as a residuum. Although he alleged complete inability to move the right leg, yet when it was picked up he held it extended some distance above the bed for some minutes before letting it drop. There was anæsthesia of the foot and leg up to the knee. He was got out of bed, shown various movements of the leg, encouraged to walk, at first with support, then without it, and was discharged fit for duty in three weeks.

In another case the patient was similarly at first paraplegic after "frost-bite": the right leg soon recovered, but the left remained paralysed. In this instance, besides the loss of power, there was contraction of the extensors of the foot, keeping the foot strongly dorsi-flexed. Anæsthesia to touch, pain, sense of position and movement extended as high as the knee and was complete, so that without looking at his foot he had no idea of its position. He also made a rapid recovery.

Hysterical contractures of the limbs without paralysis

are not so common, and I have met with no examples of a pure contracture so far in these war neuroses.

In long-standing hysterical contracture sensory disorders are often absent, and less often they are absent in cases of paralysis, and the diagnosis without this aid is certainly more difficult. Hysterical paralysis and anæsthesia may complicate the paralysis due to an organic lesion, when the functional disturbance has to be unravelled from that directly due to the lesion. With a little care the distinction can generally be made. Lapse of time is often an aid, as the functional disorder tends to clear up or to alter whilst the case is being investigated and treated. Sometimes hysterical disorders of motion—especially perhaps contracture—or of sensation are grafted on to a lesion of a peripheral nerve or nerves, but the commonest complication of this kind is for a hemi-anæsthesia of the whole body to accompany a lesion of the cerebrum. Sometimes there is hemi-paresis as well, but one must bear in mind that if hysterical anæsthesia is profound, and affects deep sensation, this generally involves loss or impairment of movement of the affected limbs.

In one case of wound of the back there was a complication of a mild Cauda Equina lesion with hysterical paresis of the legs. A bullet was removed lying external to the spinal column at the level of upper part fourth lumbar vertebra; there was a limited lesion of the Cauda Equina. At first he could not empty his bladder, and had some loss of control over the rectal sphincter. Some time after the injury paresis and numbness of the legs came on gradually. When seen six months after it the bladder and rectal symptoms had cleared up, but on the right buttock there was a well-defined area of loss of all forms of sensation in the field of the fourth sacral root; on the left side it was more extensive, involving as well part of the field of the third sacral. On

both sides the sensory loss was of the peripheral type, the epicritic being slightly larger than the protopathic loss. There was paresis of the legs, he could only walk with two sticks, and could not raise the legs off the bed, nor when seated with his feet on the ground the toes from the floor. There was no wasting of muscles, nor alteration in electrical reactions. Each leg as high as the knee was the seat of "stocking" anæsthesia, of which the upper border was sharply defined. Loss to light touch and hot and cold was complete; to pain (pin-prick) partial only.

In some cases where hysterical monoplegia has lasted for a considerable time there may be definite wasting of the muscles of the limb. This wasting is of slight degree and affects the muscles of the whole limb, as in disuse. The electrical reactions are retained. Thus a man who had a superficial wound above the fold of the elbow which could not have injured the nerves or any deep structures, complained of paralysis of the forearm and hand. There was distinct but slight wasting of all the paralysed muscles. The wrist-jerks were feeble or absent, elbow-jerks unaffected. In this case there were no sensory disorders. He made a good recovery.

In dealing with all these cases, the essential point is for the observer to be absolutely confident of the diagnosis; failure in treatment may result from some doubt in his mind as to the correct diagnosis, and hence hesitancy in carrying out appropriate measures of treatment, with consequent failure to gain the patient's confidence.

Another form of hysterical disorder which has come under observation is the common type of aphonia succeeding a laryngeal catarrh, which has shown the same tendency to relapse and the same difficulty of permanent cure that is met with in civil practice.

We have had a number of cases of complete dumbness

with or without deafness from shell-shock. In most cases the cause was the shock of a shell explosion, with or without burial, sometimes producing loss of consciousness for varying periods, sometimes not, but in either case leaving the patient in a dull, dazed or stuporous state, from which he emerged to find himself dumb and often deaf as well. When the result was both deafness and dumbness, in most cases hearing was recovered before speech, but in two speech before hearing. Recovery took place in some quite suddenly, sometimes at a concert, or under some excitement, but in others gradually, with the recovery of a few words first. In these the recovery was attended by a marked stutter. Recovery was aided by demonstrating to them the physiological movements of the lips and tongue in forming labials and linguals and getting them to imitate the movements, first of the " voiceless consonants." The patients were generally able to read and write, to understand writing, and to a limited extent use gestures. In the modes of recovery the cases corresponded to what is seen in hysterical dumbness, but in some other respects several of them differed from the behaviour of a patient with the classical type of this affection. For in this type the patient is eager to write what he cannot say, or tries to convey his meaning by elaborate and exaggerated gestures. He waits with pencil and paper ready for the doctor to reach his bed. Although some of the patients showed this eagerness, others were dull and apathetic, and apparently had little desire to attract notice or make themselves understood.

Similarly in a case of deafness from shock without lesions of the ears the patient did not make the efforts to hear that a deaf person does, *i.e.* he did not use the gestures or attitudes of the deaf, and had not the expression of one trying hard to hear.

Hysterical vomiting has occasionally occurred, either

as an isolated symptom, or associated with other symptoms of shock. This affection is apt to be refractory to treatment. In two obstinate cases no improvement was obtained until the patient was strictly isolated. Treatment by neglect of the symptom or by putting the patient at once on to a full diet whilst isolated, which is often a most successful plan in civil practice, here failed. The patients were cured by keeping them strictly to milk until vomiting had ceased for some time, and then gradually getting them back to a full diet. It was difficult in a few of these forms of hysterical disorder not to think that the patient has little desire to get well, and it takes time and some insistence before he can be got into a more healthy frame of mind.

Except in one instance, I have seen no case of hysterical convulsions, which is perhaps contrary to what one would have expected. This patient had severe fits (hystero-epilepsy), occurring in series. He was twenty years of age, and had never suffered from epilepsy. He had a slight wound, and fell back into the trench from a height of six feet, striking the back of his head. There was no mark from this injury. He was drowsy and mentally dull on admission, and a week later began to suffer from fits. They followed one another at short intervals, in series lasting from one to two hours. In the fits the arms were first raised and extended in clonic spasm, if held he resisted violently, he then turned on to his right side with rigid extension of legs and back in opisthotonus. There were irregular movements of the eyeballs, and an interesting feature was well-marked Hippus. Though the tongue was protruded, it was never bitten. Complete loss of consciousness were doubtful. He was morose and sullen between the attacks, when he had paresis with ataxy of movement of the left leg, which was anæsthetic up to the knee. There was also "glove" anæsthesia of the right forearm and hand. The visual

fields were concentrically contracted. These fits recurred with intervals of a day or two for about a fortnight, he was then strictly isolated in a small ward with an observation window and his bed made up on the floor. For a week he had occasional very slight attacks, generally when the nurse came into the ward. No notice was taken of them, and in a fortnight they had altogether ceased. The paresis of the leg and the anæsthesia cleared up without any treatment. He returned to the general ward, and remained there about three weeks, to make sure no relapse would occur. At first he was dull and listless, but later cheered up and made himself useful in the ward. He was discharged well. Probably he was not quite up to the normal intelligence.

In the above cases which show various forms of hysteria in some there is freedom from symptoms of nervous shock, either because of the conditions under which the affection originated, or because such symptoms, though present at first, had passed off before the patient came under notice; but in others the hysterical features were accompanied with more or fewer evidences of that state of general nervous shock which was present at some time in all the cases now to be considered. We are here dealing with neuroses which present symptoms or groups of symptoms not familiar in civil practice before the war. With regard to these war neuroses, I refer again to what I stated at first, that their exact pathology is doubtful, and their nature not always the same, not due to the same cause, and that it is possible that some of them are due to direct mechanical injury to the brain, cord, or nerves from the violent concussion of high explosives, yet without signs of external injury. As an extreme instance of what may occur in this way, a patient under my care has all the signs of a total transverse lesion of the cord in the lower dorsal region, including a huge

sacral bedsore, from the explosion of a shell in his immediate neighbourhood, and yet there is no damage to the spinal column nor any external mark of injury.

Apart from such a case, where the evidence of severe structural damage is conclusive, I may also reiterate that the absence of the clinical signs of structural change in the central nervous system does not necessarily prove that there are none, especially of the nature of minute but numerous lesions. In this connection the lectures of Dr. Mott,[1] especially with regard to the effect of CO poisoning, deserve careful study.

For the reasons already given, I have taken a clinical basis for the following observations, namely the absence by the ordinary clinical methods of investigation of any signs of a gross or structural lesion of the nervous system.

The causes of the war neuroses are manifold, and comprise the effects of anxiety, overstrain, of want of sleep, of wounds of varying severity, of the concussion from high explosives, of the perpetual noises which probably have a cumulative action upon the nervous system, of the horrors of the scenes through which the patient has passed, and in some cases, and very naturally, of fear. But the most potent factors in causation of nervous shock are the concussions caused by high explosives and burial in the debris produced by a bursting shell. These were the especial causes in the most severe cases under my care, and the longer the patient was buried before being dug out the greater the effect. I am in agreement with those who have found that in the majority of these patients, when the family history is inquired into, there is evidence of some neurosis or nervous disease in the patient's family.

Sometimes the patients have previously stood the strain well, but began to show the effects of nervous shock or fright

[1] *Lancet*, 1916, vol. i. pp. 441 *seq.*

when under fire after an attack of dysentery, of influenza, or some similar debilitating disease.

In all cases, whatever the variety of the predominant features, there are certain common symptoms, varying in degree, and not all present in the same case, of which the most important are exhaustion or prostration, both bodily and mental, with consequent lack of interest in surroundings, even in the progress of their own illness, and sometimes even an absence of desire to get better. For a varying time, often a long one, the patients are incapable of making any effort, and exertion of any kind entails speedy fatigue. Mental lethargy may be marked and persistent. There is often wasting or disturbance of nutrition, with or without anorexia. Neither glycosuria nor albuminuria are features of the condition.

The mental state in the early stages of the illness is one of depression, with loss of self-confidence. I have not met with hallucinations or delusions, except in patients suffering from a definite psychosis. The depression is often associated with fears of permanent paralysis or ill-health. Even when this is not mentioned, it is often at the back of the patient's mind, and if satisfactory assurance can be given on this point, there is often a speedy improvement in the depression. Tremors of the limbs may be a source of worry. The patients are extraordinarily sensitive to noises, and sudden, unexpected noises may upset them for a day. Often a sudden noise produces a sense of spasm of the chest and difficulty in breathing ; possibly this, in cases where CO poisoning has played a part, may be an unconscious revival of their first symptoms. Hence at first they prefer to be, and get on better, alone in a small ward. A sign that the first stage of irritability with depression is passing off, is a request to be moved into the general ward. Exceptionally they are afraid to be alone, and will rather put up with the discomfort

from the noise inseparable from a large ward than be by themselves.

Concentration is slow, thought painful; when asked to carry out three simple orders this will be done very slowly in the early stages of illness, and in the majority of cases incorrectly, obviously involving a painful effort.

Memory for events following the injury is imperfect, and immediate memory often very poor, though rarely so bad that the patient cannot remember if he has had his breakfast or dinner. From this cause, and from difficulty of concentrating the attention, the patients at first rarely read, for they find they cannot follow a connected narration of events or a story. Another sign of improvement is when the patient voluntarily begins to read. In the milder cases memory for remote events before the war is not affected, but in the more severe this also may be bad, even for incidents of boyhood. No doubt difficulty in reading or carrying on any occupation needing good vision is often largely due to easy fatigue of the muscles of accommodation, and blurring of vision from this cause is a common symptom at first. The mechanical act of writing is often good, but at the same time writing a letter may be a very arduous task; the difficulty here is in the construction of sentences.

Affections of the special senses—amaurosis, deafness, loss of smell and taste—are common soon after the accident, but seldom persist long. A moderate degree of deafness is the most persistent.

Nystagmoid movements of the globes are not infrequent, definite nystagmus I have only seen in one case. In view of the extreme proneness to fatigue, a medical examination has at first to be carried out with caution, as if unduly prolonged, it may throw the patient back for days. Hence it is rarely possible, and certainly undesirable, to attempt a complete examination at one sitting. The same applies to exercises

when these are begun : if unduly pushed at first, the patient may be upset for two or three days, and lose sleep and appetite. To many the nights are a source of dread. More or less insomnia is at first the rule, and sleep is disturbed by terrifying dreams. The most common dream is a sense of falling through space. Other dreams repeat incidents of the fighting ; the patient is buried again in the trench, or is in a hole and cannot get out, or is being attacked by Turks, or grasped by the enemy, and cannot get away. From such a dream the patient wakes sweating profusely and in a general tremor ; sleep is often gone for the rest of the night, which is filled with visions of dreadful experiences and sights seen in the trenches, and as a result, if the patient is suffering from tremors of the limbs, these are increased during the next day.

Less commonly the patient wakes suddenly in a similar agitation, but cannot recall the actual dream. Occasionally there are day dreams, or states in which a phantasmagoria of incidents of the fighting pass before his eyes. With regard to tremors, there is often a fine general tremor of the limbs, occasionally present during rest, more often conspicuous on movement. In one case the tremor exactly resembled that of disseminated sclerosis, but as a rule it is a fine tremor. In a few cases the head trembled whilst the limbs were steady. Further, in two or three instances in which there was a marked loss of the muscular sense, the tremor resembled that of Friedreich's disease, the hand making swooping movements before attaining its destination.

Of course tremor, especially of the head or legs, is one effect of the emotion of fear which is at work in some of the cases. I think that excessive tobacco smoking is in man a contributing cause of tremor.

Such being a short summary of the more striking general symptoms, it should now be said that these are associated

in many cases with paralysis of some part of the body. In some, from the first, standing out from the general disorders, there is a more defined loss of power either hemiplegic or paraplegic in distribution. When a localised paralysis starts from the time of the injury, it is more frequently hemiplegic. But more commonly there is at first more or less general loss of power of all the muscles of limbs and trunk, and later, often after some weeks, as the signs of general shock begin to pass off, those of a more localised affection declare themselves, and this is especially a paraplegia. The cranial nerves, other than the oculars in the forms above mentioned, invariably escape.

The chief features can be best illustrated by an example of a severe case in which all the limbs were affected at first, the upper extremities slowly recovered, and paraplegia remained. Sensory disorders were especially prominent. The patient, a man aged forty, received an injury to the head sufficient to cause a scalp wound, but no more serious damage ; if there was any loss of consciousness it was very brief. On admission, three months after the injury, he was fat and looked well, but could not stand or walk, and his hands and arms were very feeble. He complained of headache, slept badly, and had a poor appetite. Except for occasionally glancing at the paper, he was content to lie all day doing nothing, in a state of mental inertia. Reading and writing were difficult because any effort readily produced extreme fatigue ; moreover, his memory was bad, both for remote events and those of the day, *e.g.* he could not remember where he went to school, and was not always sure whether he had had his dinner. All answers to questions were made very slowly and after some interval.

He could feed himself slowly, carry out a few movements of arms and hands, and just raise his feet from the bed. The muscles were not wasted ; when passively moved there was

a sort of plastic state, not true rigidity, and a tonic spasm was sometimes induced thereby. A brief repitition of the few voluntary movements possible resulted in the muscles passing into a flaccid condition. Arm movements were attended with the "swooping" tremor above described. Superficial reflexes were normal, deep exaggerated.

On the sensory side concentric contraction of the visual fields was easily induced by testing them. There was all over the body a certain dulness to perception of a light touch or pin-prick, attributed to mental dulness. With his eyes shut he did not recognise objects placed in his hands, and had absolutely no idea of the position of any of his limbs, nor whether they had been moved, except that he recognised vaguely movement of the large joints through an angle of 90 degrees. Moreover, if I held up his left hand and asked him to touch his left forefinger with his right forefinger, he would completely fail to do so; but if he touched my hand instead, would keep his finger on it, and rest satisfied that he had correctly done what I had asked. Sometimes he was satisfied by merely making a movement of the finger in any direction. If I then moved his hand away, he was completely lost as to its position. There was one interesting point, if he had once seen the position of a limb and it was not moved, he remembered its position, and could touch it even after a long interval.

Localisation was very imperfect for instance; on both hands it was from two inches to four inches out, generally in a proximal direction on long axis of the limb, he rarely failed altogether, but was always very slow.

After two months he was somewhat less dull mentally, and took more interest in his surroundings, but was still inert His memory had improved, he read more, and was successfully making a rug. He had now fair use of his arms and hands. The legs had lost the little movement possible

on admission, they were more anæsthetic to touch and pain —he had no sense of their position or movement, and there was distinct cataleptic rigidity, *i.e.* when placed in any position they remained rigidly fixed in this position for some time. He could sit up in bed. Reflexes were in the same condition as before. State of nutrition of the muscles good, and electrical reactions normal throughout. He appeared to be capable of making very little effort towards recovery, and except for the recovery of the arms, the result of various kinds of treatment has so far been unsatisfactory.

In the cases in which hemiplegia was the predominant symptom there was as a rule a period of unconsciousness after the injury, whether due to the explosion of a shell or to being buried in the debris of a trench or to shell or bomb wounds on the trunk or limbs. The hemiplegia, sometimes at first complete, was subsequently a more or less severe heim-paresis. The deep reflexes were exaggerated on the affected side. The paresis was frequently accompanied by some ataxy or inco-ordination of movement.

Sensory symptoms of a certain kind were marked. Common sensation was as a rule unaffected, and the hemi-anæsthesia of hysterical hemiplegia, an important point in discrimination, was not found. In one case there was loss of light touch over the hand and forearm, and also asynergia and apraxia of this limb. With eyes shut movement was inco-ordinate, he could not recognise common objects placed in the hand, nor put them to their proper use, nor discriminate between weights, and he had no knowledge of the position of his hand.

In the other cases objects were recognised, though generally slowly; but there was defect or loss of localisation of touch, defective discrimination of two points at the normal distance, or total failure to discriminate them, loss of power to appreciate different weights, and of the position and of

degree of passive movements of the affected limb. For the latter I used Dr. Head's method of testing, and I gladly here express my indebtedness to his writings and demonstrations on these features.

Localisation was generally, though by no means invariably, proximal along axis of limb to the spot touched. Sense of movement was most imperfect at the periphery, thus it might be completely lost for the fingers, very imperfect at the wrist, and fair or good at the elbow, and good at the shoulder. The same applies to the lower extremity. In one case there was the very interesting symptom that the patient, if he put down an object he had been holding in the affected hand, entirely forgot where he had placed it, whilst when using the other hand he had the normal memory of what he had done.

In all cases electrical reactions were normal: the muscles on the affected side were flabby without sign of rigidity at any period of the case.

In one case on the hemiplegia side alone there developed gradually a very marked intention termor, which was practically indistinguishable from that of disseminated sclerosis, and which persisted so long as he was under observation. Other evidences of disseminated sclerosis were, however, absent.

The results in these hemi-paretic cases were good. Treatment by rest, good feeding, massage, passive movements and exercises resulted in restoration to health. The leg in all cases recovered before the arm.

More common than hemiplegia or hemi-paresis as the residual affection, when the general symptoms of nervous shock are in process of subsiding, is some form of paraplegia; a monoplegia I have not come across.

These paraplegias are of all grades of severity: two examples will serve to illustrate the milder forms.

A man was buried twice and concussed by shell fire: he became unconscious and remembered no more until four days later, when he recovered to find himself partially blind and deaf, with loss of smell and taste and paraplegic. On admission fourteen days later he had recovered the use of his special senses and the general symptoms of shock were passing off, but he could not walk, and could only stand with support. He was much troubled by fears of paralysis. He had slight defect of sense of position and of movement of legs, but no other sensory changes. All reflexes normal. When he began to try to walk he had an extraordinary gait; the legs were held absolutely rigid and violently jerked out, whilst his head and trunk were thrown so far back that he looked as if he would fall on the back of his head. The nature of his trouble was explained to him, and being an intelligent man he steadily persevered, aided by massage and passive movements, and in three weeks had completely recovered. He said that "he had fought hard to recover."

In another patient who was blown up by a mine and was unconscious for three days, the signs of nervous shock were still severe on admission and he was kept in bed in a ward by himself for three weeks, until they gradually improved; at the end of this time, when he was allowed to get up, it was found that he could not walk, and could only stand by holding on to something. There was a tremor of the legs, and he said that he felt very uncertain as to their position, though all that could be found on examination was some defect in the senses of position and of movement of the right foot only. At first when he tried to walk his feet seemed to cling to the floor, so that he scraped them along it, whilst at the same time the legs were agitated by a coarse tremor or clonic spasm of the muscles and he brought each leg forward with a violent muscular effort, an appearance further borne out by the increased rapidity of pulse and respiration. He

recovered more slowly, and at the end of a month walked normally, though if he went far the tremor of the legs returned.

In these milder cases, with their individual peculiarities of gait, there is nothing that is not seen occasionally in ordinary practice, but in the severer cases of paraplegia there are more unusual features. In these severe cases there is a good deal of individual difference. In some there are marked disturbances of the deep sensibility and of localisation of touch without muscular wasting or evident loss of muscular tone. This type has already been sufficiently described above. In others the paraplegia was also complete, long lasting, without or with slight sensory disorder, but with flabby, flaccid and wasted muscles, the wasting of the leg muscles being general. In this type of case, which was to me at any rate a new one, there was a varying degree of tenderness of the dorsi-lumbar spine with stiffness on movement. The muscles were often tender. The electrical reactions were normal to Faradism and to the Condenser, but increased to Galvanism without qualitative change at the two poles; continued Faradism did not quickly exhaust the muscles.

The deep reflexes were exaggerated, true ankle-clonus was not found, Oppenheim's reflex occasionally, the plantar was never a true extensor, but sometimes there was a quick extension of the whole foot.

In one case there was in addition to general also more pronouced local wasting of one Quadriceps Extensor; this muscle showed decreased response to both Faradism and Galvanism and KCC = ACC.

The patients could move their legs to a limited extent when lying in bed, but the repetition of such slight voluntary movements as were possible quickly tired them out; further, these movements showed very peculiar features. To produce

a slight movement gave the appearance of a man making an extraordinary effort, as of one lifting a heavy weight, all the muscles concerned in the movement, both prime movers and antagonists entered into (1) tonic spasm lasting some seconds, succeeded by (2) slow clonic contractions of the same muscles, which slowly subsided as (3) the desired movement was finally carried out. These phenomena were repeated each time the movement was made.

In addition there was sometimes also a peculiar and allied modification of the tendon-phenomenon. If the patellar tendon was struck two or three times in succession there followed, first, a rather slow jerk, and then a sustained spasm of the Quadriceps, in which the muscle remained firmly contracted for from 15 to 30 seconds, and then slowly relaxed.

When the patients tried to stand or walk their legs doubled up or slipped from under them. The patient may know perfectly the position of his limbs, and in bed both deep sensibility and common sensation seemed to be unaffected, and yet had no control over them when out of it. The sphincters were unaffected.

Three of the patients recovered completely, with the others little progress has so far been made. The patients who recovered after preliminary treatment by massage, electricity and passive movements, under which the muscles gained in size and tone, had to be taught to walk step by step, and did not improve much until it was realised that they must be shown how to carry out each detail of the movements of walking, then they made fairly rapid progress. It was not so much that they were devoid of the sense of position or movement of the legs, but that they seemed to have lost the automatic or subconscious representative mechanisms of the movements of walking, which had to be built up again. One movement, extension of toes with dorsiflexion of foot, seemed especially difficult for them.

Looking at the cases as a whole, the conclusion seems inevitable that whatever the exact nature of the pathological changes, they must be widely distributed through the nervous system. In accounting for the symptoms, we must not leave out the mental state at one end of the scale, nor the failure in muscular nutrition at the other. The disturbance affects the highest cortical levels, the middle levels with the subconscious mechanisms for everyday activities, the motor centres in the cord with their issue in the final common path, and the muscles themselves, and often also the afferent paths and the receptive apparatus for localisation and the components of deep sensibility. The variation of symptoms in individual cases will depend upon what paths, centre or centres the incidence chiefly falls.

Where disorders of deep sensibility are prominent this is probably sufficient to account for the disorder of movement. The dull mental state of the early stages, suggest that cortical voluntary impulses are then defective. In other patients the condition of the muscular apparatus and presumably of the spinal motor cells on which their nutrition depends, would alone be sufficient to cause paralysis, even if the higher nervous system were intact.

Though one must be guarded in drawing conclusions from appearance only, the impression generally conveyed is that of a block in the passage of nervous impulses from one neuron to another. Especially is this so in those cases in which the mind seems to have fully recovered, and the muscles of the legs are strong and well nourished, and yet the patient has no power to move them. It looks here as if the resistance of the synapses has been so greatly increased that impulses could no longer pass. It has been suggested, I think by Dr. Mott, that one effect of the concussion from high explosives may be to cause a retraction of the terminals of neurons, and so leave a space over which impulses cannot

pass. It is possible, however, that the difficulty may be due, not to separation in space, but to alteration in the constitution of the terminal ramifications of the axones and of the dendrites.

The peculiar disorder of voluntary movement described above shows, if my observations are correct, disturbance of the reciprocal innervation through the final common path of the muscles concerned in the movement Instead of the normal process of a maximum innervation of the prime movers and a simultaneous inhibition of their antagonists, or at most as in some movements a moderated contraction of antagonists for the purpose of ensuring steadiness of a movement, in this disorder both agonists and antagonists are strongly innervated together, the result being not the desired movement, but a spasm of the limb in the position of the strongest set of muscles.

I would further refer this disorder of voluntary movement to an overaction of the cerebellum, or perhaps rather to the want of counteraction of the cerebellum, owing to the impulses from the cerebrum being in abeyance.

Briefly stated, the argument in favour of this view of unopposed or exalted cerebellar action is based, (1) on the dual structure of muscles, for according to Boeck's morphological researches one component, a sarcoplasmatic mass, is innervated by a sympathetic motor cell, and the other, the striped apparatus, by an anterior horn cell; (2) on Langelaan's observations on muscle tonus, in which, in experiments on tendon-reflex phenomena, a tonic tetanus is shown to precede clonus, and to be due to exalted irritability of the proprio-ceptive arc, and clonus itself to be a series of twitches (due to the anterior horn and striped apparatus component of muscle), superimposed upon a tonic tetanus, (due to the sympathetic component) ; and (3) on Sherrington's

view that the cerebellum is the main ganglion of the proprioceptive system[1].

Finally, I may say, and it is perhaps contrary to expectation, that cases of conscious simulation of nervous disorders have been conspicuous by their absence, and that the influence of fear is not so great nor so lasting as one would have anticipated, for all men are not constitutionally brave, and the conditions of modern warfare are such as to daunt the stoutest heart. That, however, in a few the fear of a return to the front does retard recovery is certain, and in the case of a man for whom there is no possible prospect of returning to active service it is well to tell him so.

NOTES ON THE ENTERIC GROUP OF DISEASES AS SEEN IN AN ISOLATION HOSPITAL IN FRANCE.

BY

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IN this paper I propose describing first the general arrangements of the hospital to which I was attached and the measures taken to isolate patients and prevent the spread of infection, and in the second part to give my own impressions as to the clinical features of the enteric group of cases, more especially with reference to Paratyphoid B.

The hospital consisted primarily of eight huts, each

[1] For these points I am indebted to Langelaan's valuable paper on "Muscle Tonus—Brain," vol. xxxviii. part iii. p. 235. Although his experiments quoted refer primarily to tendon-reflex phenomena, and the disorder I describe is one of voluntary movement, yet they seem to me comparable, especially in view of the peculiar modification of the knee-jerk, which sometimes was present in the same patient.

120 feet by 15 feet, arranged in two sets on either side of a central path with their ends opposite to each other. Being somewhat narrow, only one row of beds could be placed in them, though a few beds could be put lengthwise against the opposite wall. Besides these huts we had eight "Armstrong Huts," made of canvas, holding two or three beds each; they are very nice in the summer when the side can be opened and an awning fitted to it, but we found them rather chilly and dark in the winter. We had also a number of bell tents, and later on the hospital was extended into hospital marquees, which were put up in a field below that on which the original huts were erected.

The various administrative buildings were constructed of corrugated iron and wood, and were placed on two adjacent sides of the square block of buildings formed by the wards.

The first thing found necessary was to divide the long huts into two parts, in order to isolate patients suffering from different diseases. We allotted wards or half wards to various infections as we thought they would be most likely to be required; but we soon found that the greater part of our wards would have to be given up to enteric, and that the arrangement of the remaining part would constantly require modification according to the prevalence of one or other of the infectious diseases. The Armstrong Huts were intended for officers, and were during the summer largely used for their accommodation, but some of them were generally kept for infections, such as scarlet fever or measles, of which we had only a few cases at a time, and were allotted to men. During the winter officers with enteric were placed in one of the half wards, and in the spring an officers' ward was built with separate rooms, holding two beds each, and kitchens, bathroom, etc., to itself. The bell tents were used for observation cases, but most of these were taken down in the winter, the Armstrong Huts being used instead.

The two main improvements made to the wards were the erection of a small sanitary annexe (6 feet by 6 feet) at each end of the long huts, and the construction inside the wards of a small sister's duty room and a scullery (8 feet by 5½ feet), with a passage between them in the centre of the wards where the partition came.

A wooden reception-room and a large kitchen and stove for the service of the Armstrong Huts were also built during the autumn.

The regulations and arrangements for preventing cross infection and the spread of diseases from the hospital were briefly as follows.

All food for patients and orderlies was cooked and sent out from the hospital kitchen. The sisters and orderlies were not allowed to have any meals or food themselves in the wards, but took all their meals in their own respective messes. The orderlies on duty in the wards wore hospital blue, with their uniform caps, and both sisters and orderlies wore overalls. The orderlies changed their clothes when coming on and off duty in one of the sanitary annexes which was kept for the purpose. (The other sanitary annexe was used for keeping urine bottles and bed-pans.) Orderlies were not allowed to smoke on duty or to carry cigarettes behind their ears.

The kitchen had three storerooms, where meat, vegetables and milk were kept ; they were partly shut off from the main kitchen, and were covered in with muslin. Bread was kept in a fly-proof cupboard with gauze sides in the steward's store. Each patient had his own plate, bowl, spoon, and feeder, which were numbered and belonged to his bed.

The disposal of excreta and water used for washing patients was as follows. Bed-pans as soon as used were taken by the orderly to the destructor, covered by a cloth. The

contents were mixed with sawdust and burnt in Horsefall destructor. The bed-pan was left with the sanitary orderly, who placed it in cresol till disinfected. It was then returned to the ward. Urine was carried in the bottle as soon as it was passed to the same building, and poured into a large boiler, and the bottle placed in a tub of cresol in a small adjoining room. The orderly carried back a clean bottle from the shelf in the same room. The urine after boiling was run by a pipe into a large soak pit. Water used for washing patients was also boiled in the same way before running into the soak pit. On the arrival of an ambulance with a suspected enteric case, the patient was taken on his stretcher to the reception hut, seen by the O.M.O., and his particulars taken by the N.C.O. on duty. The ambulance was sprayed with formalin, and a new stretcher and blankets given to the driver. The O.M.O. then sent the patient to the reception ward, the stretcher was sprayed, and the blankets and patient's kit taken to the steam disinfector.

At night the O.M.O. attended to the patient and if necessary called the M.O. who would have charge of the patient. During the day the M.O. saw the patient at once, and took a specimen of blood for the pathologist. In the course of the next twenty-four hours it was usually possible to say either on clinical or pathological grounds whether the patient clearly had an enteric infection, or whether he was a doubtful case who would require further watching and observation before a definite diagnosis could be made. He was then transferred either to an enteric ward or an observation ward ; if the preliminary classification eventually turned out to be wrong he was again transferred to his proper place in the hospital. Those against whom no evidence of enteric infection could be brought either by the clinician or the pathologist found their way eventually into a special ward reserved for " wash-outs," and were labelled influenza

or myalgia or P.U.O. according to circumstances. These patients, when well, were sent to their base depots or to the convalescent depot at the discretion of the M.O. The pathological investigations included at least one blood culture, three agglutination tests against Typhoid, Paratyphoid A. and Paratyphoid B., and three examinations of the fæces and urine for organisms. When fit to walk about and take light exercise, all enterics were evacuated to England, and notes of the case typed on the back of their transfer certificates signed by the C.O.

These measures were very successful. I can remember only two orderlies who contracted enteric, and though we had some cases of double infection among patients, I can remember only one in which we certainly thought that the second infection might have been acquired in the hospital. Of course, constant supervision of the orderlies was necessary: lectures were arranged for them and given by the M.O.'s which dealt with infectious diseases and sanitation. If they were caught disobeying rules, the matter was reported to the C.O., and punishment inflicted when it seemed necessary.

The "Enteric Group" is taken to include Typhoid, Paratyphoid A. and Paratyphoid B. and the term "enteric" is not used as synonymous with typhoid, but as designating the group. In making returns, if the bacteriological evidence was not sufficient to identify a case, but clinically the patient appeared to have one of the three diseases, we were instructed to diagnose it as "Enteric Group." The proportions in which the three diseases occurred were roughly 10 per cent. Typhoid, 4 per cent. Paratyphoid A., and 81 per cent. Paratyphoid B., the remaining 5 per cent. being "Enteric Group."

It is, of course, impossible to diagnose clinically the presence of a particular causal organism in any disease. This can only be done by means of bacteriological investigation.

But just as diphtheria can be in practice distinguished from other forms of tonsillitis in a number of cases, so it is occasionally possible to give an accurate guess as to which of the enteric groups a patient belongs. But, as a rule, this can be done only when the patient has been under observation for some time, and the general features and course of the attack have been noted. It is more possible to distinguish clinically between typhoid and the paratyphoids than between Paratyphoid A. and B., though in some cases the former present suggestive features. Practically, however, the diagnosis always rests with the bacteriologist, and no clinical diagnosis is accepted other than that of "Enteric Group." I propose now to set down some rough notes on the symptoms and course of the paratyphoid fevers as I saw them.

1. *Onset.*—The mode of onset appears to have some relation to the severity of the attack. Three types may be distinguished. Those in which the onset is quite abrupt; the patient goes to bed feeling quite well, and wakes up next morning unable to go on duty. In the next group there is a week or less of prodromal symptoms, not very serious or definite in character. In the third these prodromal symptoms are noted for a longer time, and the onset is more gradual. A larger proportion of severe cases were found to follow on this third type of onset, and the smallest proportion to follow the first type of onset.

Initial symptoms are many in number, but by far the most frequent is headache. Diarrhœa and shivering are not uncommon, and sometimes pain in the back and abdomen; vomiting and cough are less common. Fainting, nasal catarrh, laryngitis of mild type, herpes labialis and conjunctivitis are occasionally seen. Epistaxis is not a frequent initial symptom, but is not uncommon at some period in the attack.

2. *Pyrexia.*—In our cases of Paratyphoid B. we found

about 80 per cent. with ten days' fever or more, and 20 per cent. with under ten days' fever. In analysing the former group I was able, I thought, to distinguish the following types :—

(*a*) Simple continued fever, often with a tendency to remission, but with no very characteristic curve.

(*b*) Intermittent type, the intermissions usually occurring towards the end of the attack, but sometimes at the beginning, or more or less throughout. Nearly half the cases showed this type of fever, which is illustrated by Chart 1.

(*c*) Undulant type. In half these cases the notes showed that there were more or less well-marked pulmonary symptoms, but beyond that the type of fever could not be correlated to any other features in the attack. (Chart 2).

(*d*) Low, irregular fever. In this type, often after a few days' high fever, the temperature fell to normal or subnormal in the morning, but rose to 99 per cent. or 100 per cent. F.

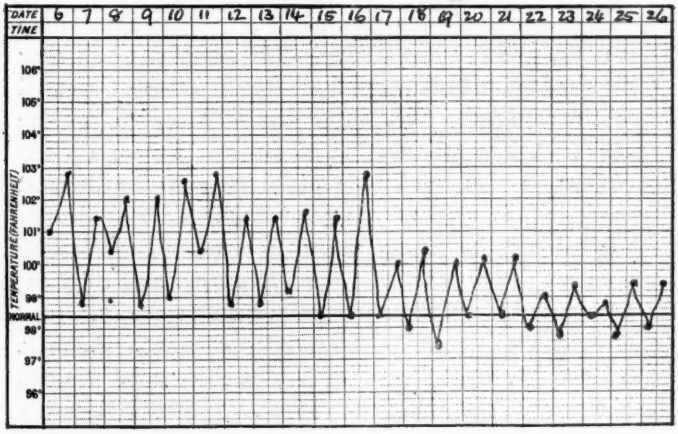

CHART 1.

Intermittent type of pyrexia. Paratyphoid B. isolated from urine 18th day. Agglutinations positive to Paratyphoid B.

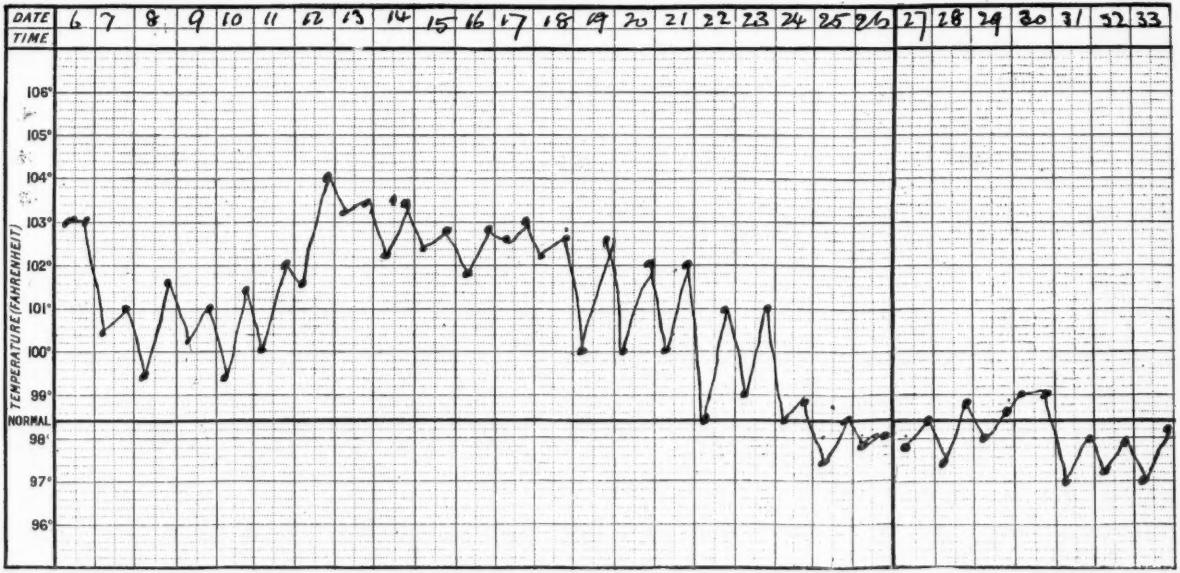

CHART 2.

Undulant type of fever. Paratyphoid B. isolated from fæces on 8th day of disease. Agglutinations positive to paratyphoid B.

in the evening, and sometimes a little higher. The attack was often prolonged.

(*e*) In a certain number of cases, a week or so after the temperature had fallen there was a sudden rise of temperature lasting about twenty-four hours, usually accompanied by headache or general pains. These rises were sometimes repeated several times. We often found the spleen tender, but could not detect any tenderness over the gall bladder, which has been noted by other observers. The attacks are not serious, and the patient is generally well the next day. (Chart 3).

3. *Facies and Constitutional Symptoms.*—The patient's appearance is often quite without any diagnostic significance but in some cases he has a peculiar heavy, "bloated," coarse appearance, which is rather suggestive. The constitutional disturbance may be considerable, but on the whole in paratyphoid the patient is not so ill as in typhoid, having regard

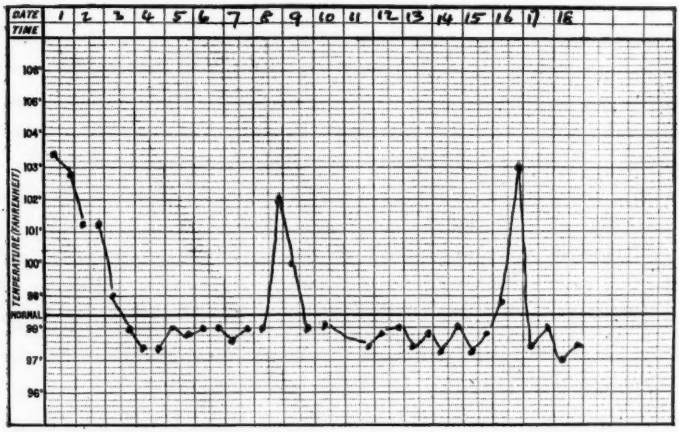

CHART 3.

Case shewing subsequent rises of temperature. Cultures negative. Agglutinations positive to Paratyphoid B.

to the duration and height of the fever. Convalescence as a rule is much more rapid and satisfactory in paratyphoid.

4. *Skin.*—The eruption is common but not constant. Its chief characteristic is its polymorphism, spots of many shapes and sizes being observed on the same patient. It is seldom earlier than the fourth day, but the crops may continue to come out for several weeks, and even after the temperature has become normal fresh spots may be observed. Jaundice was observed in a few cases.

5. The spleen is nearly always tender, and can often be felt. It is usually soft. Increase of splenic dulness always seems to me an unreliable sign.

6. Severe complications were unusual in our series. We had a few cases of hemorrhage, but none were very severe. We lost a few cases from perforation, and saved none by operation. Thrombosis, generally of the femoral vein, was not very uncommon, and one case had symptoms of pulmonary embolism from which he recovered. Parotitis and orchitis were observed, and sometimes go on to suppuration. We had one case of meningitis, one or two of boils, one of hæmaturia, and one of herpes zoster.

7. Relapses were infrequent, but sometimes more severe than the original attack.

8. As regards treatment, we relied on dieting and nursing; we tried a few cases with typhoid vaccine, but we did not think any good ensued. The mortality among the paratyphoids was very low, though I cannot now state the exact figure. Though many patients had a severe illness, but a small number appeared to be in actual danger.

9. Anomalous cases occurred in which the bacteriological evidence, including three agglutination tests, was negative, but which presented symptoms of enteric infection, such as spots or an enlarged spleen. Moreover, some cases in which the organism was isolated from the urine or fæces, failed

to show the presence of specific agglutinins in their blood. In other instances in which the bacteriological evidence was complete, the duration of the fever was so short that they might easily have been passed over or diagnosed as "febricula."

FORENSIC EXAMINATION OF BLOOD-STAINS IN THE TROPICS.[1]

BY THE LATE
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IN this essay I propose to describe in detail the examination of blood-stained articles and the determination of the nature of the blood as carried out in the Serological Laboratory in Calcutta. The Government of India instituted this laboratory for the performance of the bio-chemical tests for blood, and I have had the privilege of undergoing a course of instruction in this subject under Lieut.-Col. W. D. Sutherland, I.M.S., who is the organiser and director of the serological work. I would like here to acknowledge my indebtedness to him for permission to use the laboratory records for the purposes of this paper, and for the kind advice which he has always been so ready to give.

The blood-stained articles which came for examination from all parts of India and Burma may be classified as follows:—

1. Mud, earth, leaves and stones.
2. Swords and spears.
3. Knives of sorts: large sacrificial knives, Burmese dahs, Indian bill-hooks, sickles, daggers and pocket-knives.

[1] A dissertation for the M.B. degree taken *in absentia*, September, 1913.

4. Bamboos, " lathis," and small pieces of wood.
5. Clothes: dhotis, saris, kurtas.
6. Grains of sorts.

Owing to the climatic conditions, and the existence of a prolonged dry season preventing the washing away of blood-stains from the soil, the first class of articles is much more frequently dealt with than can be the case in temperate climates. Also the fact that natives of this country live in mud dwellings, even though these are frequently renovated inside with fresh coverings of cow-dung, made into a paste with water, chopped grass and earth, helps to swell the total number of these cases.

The cutting instruments are generally rusty, and the sacrificial knives are stained with goats' and sheep's blood, unless they have been recently cleansed.

Class 4 consists mainly of bamboos, though a " lathi " may be a stick of any sort.

Human blood is found on the bamboo in only a small proportion of cases; this may be accounted for by the presence of natural red markings on it, which to the ordinary mind suggest the probability of blood-stains, and also by the fact that red saliva ejected by betel chewers is frequently seen on staves as well as on many other articles for examination.

Clothes form the largest proportion of articles examined, and of these the " dhoti " is the commonest. This is a long, cotton loin-cloth for men, which also when required acts as a covering for the upper part of the body. The " sari " is a similar but more ornate and coloured garment for women, also serving to cover the head and the rest of the body. The " kurta," a shirt, is an additional garment for men.

There are several stains which mimic those of blood. They are red in colour and are generally quite easily distinguished at sight; the markings of the bamboo have

already been mentioned, and similar markings occur on the stalks of cereals and of Jowari (Sorghum vulgare).

On clothes are found a variety of stains, among which that due to the saliva of betel chewers can usually be seen ; also marks of mud and filth of all kinds, for the ordinary peasant has not a large wardrobe, and wears his few garments until they are full of holes.

The stains are examined microscopically, spectroscopically, and when blood is detected by either of the first two methods of examination, bio-chemically.

MICROSCOPIC EXAMINATION.

A small quantity of scrapings from the stained area in the case of earth, knives and bamboos, or a portion of the fabric in the case of clothes, is taken and allowed to soak in a drop of Vibert's solution (0.5 per cent. $HgCl_2$ solution in 2 per cent. NaCl), or in a drop of glycerine solution (one part in seven of water). It is then covered with a cover glass, and after standing for half an hour is tested and examined under low power, high power and oil immersion lenses. Mammalian blood-cells, and the oval granular nuclei of non-mammalian corpuscles can be detected ; in one case these were both found on a single grain of paddy (unhusked rice.)

SPECTROSCOPIC EXAMINATION.

A small piece of the stained cloth is cut out, dipped into boiling water for five seconds to fix the stain, and is dried with blotting paper on a slide. A drop of potassium cyanide solution, 2 per cent., is dropped on to the specimen, and when there is blood we find small cherry-red areas under the low power. Two drops of an ammoniated solution of ammonium sulphide are added, and a cover slip is applied. The specimen is now ready for spectroscopic examination.

Instead of using boiling water to fix the stain, and then adding 2 per cent. cyanide, we find that the same result may

be attained by adding a drop of saturated solution of potassium cyanide, which acts as a fixative.

The preparation, if thick, may be examined directly with the spectroscope, but it is usually necessary to examine it with the low and often with the high power of the microscope, after substituting for the eye-piece a spectroscope fitted with a scale of wave-length measurements. The specimen so prepared will, if blood is present, show the spectrum of cyanhæmochromogen, giving its characteristic bands.

In the case of earth, stones, sticks and knives a small drop of 2 per cent. potassium cyanide solution is placed on the blade of a clean scalpel, which is then used to scrape the stained area, and the stain solution so obtained is treated with the ammonium sulphide solution and then examined spectromicroscopically, as in the case of fabrics. If the examination with Vibert's solution is negative, and the cyanhæmochromogen bands are not seen, the case is returned as negative, " no blood detected." If otherwise, we proceed to carry out the precipitin reaction.

The guaiacum test (Van Deen's) is not applied, even as a negative test. The reasons for this are set forth in Lieut.-Col. Sutherland's *Blood-Stains, their Detection and the Determination of their Source* (London, 1907).

THE PRECIPITIN REACTION.

This depends upon the principle that if an animal of species A receives injections (preferably intravenous) of the serum of an animal of a not too closely related species B, its serum will, in time, develop the power of causing a precipitate to form, when it is brought into contact with a high dilution of the serum of species B, but not when brought into contact with a high dilution of serum of other species, save of those very closely related to B.

Now, if a fowl receives injection of the serum of a horse,

that fowl's serum will, after a time, have the power of causing a precipitate to form when it is brought into contact with a high dilution of horse's serum, and also ass's serum ; but no such reaction will occur if it is brought into contact with a high dilution of the serum of the goat, the cat, the camel, a man, etc.

The reaction appears to be due to a change of the electric potential of the albuminous molecules of the diluted serum. These molecules, being colloid, are in a state of suspension in the dilution. If this be true, then, if the electric potential be that of the molecules of the treated animal's serum, they will keep separate from these, and no precipitum will b formed. If, on the contrary, their potential be the opposite of that of the molecules of the treated animal's serum, they will join these and thus cause the formation of a precipitum.

As a matter of fact we find that, in adding anti-serum to a dilution of serum, if a zone of precipitate has formed, and an excess of either serum dilution, or of treated animal's serum be added, this precipitate *dissolves* ; the excess has caused all the molecules present to take on the electric potential of the matter in excess, and thus being all of one and the same potential, the molecules remain separate from each other, hence this explanation of precipitation is preferable to that which is in part based on surface-tension.

Before the test can be applied we require, firstly, normal serum of various species for injection into the animals that are to elaborate our antisera. The blood, from whatever source and however obtained, is allowed to clot and the clear serum is at once pipetted off into sterile bottles. It is then inactivated by being heated to 56° C. for half an hour, and stored in the freezing chamber till required.

Owing to the sanctity of the ox in the eye of the Hindu, we use buffalo serum ; the anti-serum obtained from the animal injected with this acts strongly with the sera of the

buffalo and ox, and also weakly with those of the goat and sheep, so that the differentiation of buffalo and ox antigen by anti-bubaline serum is only one of degree, depending on the difference in time between the appearances of the reactions and on the quantity of precipitum. The reaction of such anti-serum with goat or sheep antigen shows the same difference in degree carried a step further, so to speak.

We use no simian blood for injections, firstly, because the ordinary Lungoor (Semnopithecus entellus) is regarded as sacred, and it has not been argued in a court of law that the blood in question reported as human by the laboratory might be simian; secondly, according to the experiments of Sutherland, a reasonably strong anti-human serum should differentiate sufficiently between the blood of man and monkey within the time limit of twenty minutes. He examined blood-stains due to the blood of a number of varieties of the apes of the old world, and he states as follows:—

"It was found that even in the orang's blood-stain the reaction obtained was not human as it was not visible till after the expiration of twenty minutes, whilst the human blood-stain extracts and dilute sera in each case reacted well before five minutes had elapsed. These experiments were repeated over and over again, etc." and in no case was human reaction obtained with the extract of a simian blood-stain.

For the elaboration of anti-sera, rabbits are difficult to obtain and are prone to disease, so that fowls are used, as they yield satisfactory anti-sera. Two injections of the antigenic blood serum are given into the axillary veins, the doses are 4 c.c. and 8 c.c. at three days intervals. Fourteen days later, after a twenty-four hours' cessation of feeding, the fowls are bled into sterile flasks and the blood allowed to clot. When this has occurred, the serum is pipetted off into sterile bottles and stored in an ice chest.

In the laboratory in Calcutta no antiseptics are used for preservation purposes, the anti-serum being kept frozen and in the dark. Sutherland[1] found that anti-sera exposed to light and warmth at room temperature became absolutely inert in two or three days in Calcutta.

THE PRECIPITIN TEST IN PRACTICE.

The anti-human fowl serum is taken from the ice chest and allowed to remain in the dark at room temperature in order to thaw gradually. It is found that if suddenly warmed such anti-sera are unreliable and may give reactions with the dilutions of all the normal sera, but that if again tested after an hour or two the same anti-sera have regained their specificity. Having thawed it sufficiently a sterile capsule is filled with the anti-serum, labelled and placed in the cupboard till required. The bottle containing the stock solution is replaced in the freezing chamber.

The anti-serum has now to be tested as to its potency and specificity. This is done every day that it is used, and the technique is as follows : Tubes containing normal sera of the domestic animals and man are taken. The sera we use are human, hircine, bubaline, canine, feline and equine. Dilution of one in a thousand of 0.85 per cent. salt solution are made from each of these sera. Of these dilutions at most two cubic centimetres are poured into the pointed tubes which we use for the test, and one tube of salt solution alone is put up. Two drops of anti-human fowl serum from the capsule are allowed to run down the side of the tube, which is held nearly horizontal and has been moistened with the serum dilution it contains. The slightly coloured anti-serum can be seen descending to the bottom of the tube, being heavier than the normal serum, and the tubes are placed in the rack. If, as is finally the case, the tube containing the human serum shows a marked reaction in about two minutes, and there is

no reaction visible in the other tubes for more than twenty minutes after the addition of the anti-serum, it is considered to be potent and specific, and is used for testing the extracts of blood-stains sent for examination. The reaction consists in the formation of a cloudiness at the junction of the serum and anti-serum, best seen by examining the tube contents against a black background. For this purpose we use a piece of cardboard covered with black cloth. Two drops of anti-sera are used in order that there may be a little clear fluid below the ring of precipitum, thus making the cloudiness more apparent by contrast above and below.

Having proved that the anti-serum is potent and specific, we proceed to prepare our stain extracts for examination by its means. These extracts are made by adding a small quantity of physiological salt solution, 0.85 per cent., to the fragment of cloth, scrapings from a weapon or missile, portion of blood-stained earth, etc., which has been proved to be stained with blood as already detailed. If the blood-stain gives an extract readily, this is at once filtered in order to obtain it as clear as possible before small extraneous particles have become suspended. It often happens that owing to the hot climate and the age of the stain it does not readily become extracted ; in such cases the addition of a few drops of a weak solution of cyanide of potassium to the tube contents will hasten extraction. We owe this manœuvre to Ziemke.[2] One drop of a 2 per cent. solution if added to one c.c. of salt solution will have the desired effect. The great desideratum is to obtain as concentrated a solution as possible in the test tube at this stage.

If the extract be difficult to clear by filtration, it should also be centrifuged and then again filtered ; very few extracts save those of some earths resist these means of clarifying.

When cyanide of potassium has been used, the alkalinity of the extract must be neutralised by the addition of a drop

or two of a weak solution of tartaric acid. The extract is then diluted until it corresponds to a $\frac{1}{1000}$ dilution of serum, as is shown by the foam test. The dilutions are then treated with litmus to ensure the absence of acidity or of excessive alkalinity, and at most two cubic centimetres are formed into a second series of tubes, pointed and numbered according to the numbers on the test tubes containing the stain extracts. To the contents of each tube are now added two drops of anti-human serum, which has already had its potency and specificity confirmed. Every two or three minutes the tubes are examined, and only those stains whose dilute extracts give a reaction within the time limit of twenty minutes are entered as being due to human blood, *i.e.* they contain human albumin as proved by the precipitin test.

It is necessary to fix a time-limit in order to prevent the "mammalian reaction" from vitiating the results. As shown by Nuttall, the test is not absolutely specific: an anti-human serum that reacts well with its homologous serum will also react with other mammalian bloods if a long enough time is allowed, consequently the time-limit of twenty minutes has been adopted here, as in most laboratories.

In testing the specificity of an anti-serum, it sometimes happens that a reaction occurs with a dilution of a serum other than that used as the antigen. We have had one horse serum which habitually reacted with anti-human fowl serum; on inquiry it was found that the horse from which the serum had come was diseased.

One or two specimens of anti-human sera gave an appreciable reaction with feline and other non-human sera in dilution within the prescribed time-limit. Dr. G. E. Mitra carried out a series of experiments (hitherto unpublished) whose results go far to show that by diluting such an anti-serum—if it be highly potent for its antigen—with normal fowl serum, it can be rendered useful for forensic

work by having its potency retained in sufficient degree, whilst its specificity has been increased so that no untoward reaction will occur for half an hour.

The side action of an anti-serum with a serum closely related to the homologous serum has been overcome by Weichardt (quoted by Sutherland), who used the exhaustion method; but Sutherland,[1] working in India, found that by removing the side action of an antiovine serum for goat serum he had also destroyed its action in its homologous serum.

In this laboratory an anti-serum which shows a mammalian reaction within twenty minutes, or a side action on the serum of a closely-related species, is not used for medico-legal purposes, though it is probable that soon such anti-sera corrected by Mitra's method will come into use.

The possible sources of error in the reaction are as follows:—

1. Presence of mineral acid, or strong alkali. The tubes and extracts must be tested for acid with litmus, and neutralised if necessary with sodium bicarbonate. If potassium cyanide has been used in the extraction of the stain it must be neutralised by tartaric acid.

2. Dirty tubes. The tubes should be examined against a dark background, and any that are not absolutely clean, or are frosted, should be discarded.

3. Cloudy anti-sera. No anti-serum that is not clear should be used; it does not matter if the anti-serum has a slight red colour from dissolved hæmoglobin, in fact this helps to fix the level at which the reaction would occur.

4. Extracts cloudy. Stain extracts must also be clear. How this may be brought about has been described.

5. Too rapid thawing of anti-sera that have been kept

frozen. The thawing of the anti-serum when taken from the freezing chamber must be gradual. If this precaution is not observed, reactions are liable to occur with all the antigens when the anti-serum's specificity is tested.

6. Too little anti-serum used for the test. At least two drops of anti-serum should be added to each tube of stain extract, otherwise the reaction will occur at the very bottom of the tube, and thus will not be so well defined as it is when there is some clear fluid below.

7. Omission to test the anti-serum before use in a forensic test, as either its potency or specificity, or both, may have undergone a change by keeping.

8. Unsuitable dilution of stain extract. A precipitum is soluble in excess of anti-serum or of antigen.

Neither putrefaction nor age affects the test to any great extent.

The following specimens were examined by me :—

Article.	*Date of Stain.*	*Date of Exam.*	*Result.*
1. Clear stain on cloth..	1.7.09	14.5.13	Human blood.
2. do. do. ..	do.	do.	do.
3. Red stain on cloth ..	18.9.09	do.	do.
4. Black powder	17.9.09	do.	Spectro.-negative
5. Red stain on cloth ..	22.1.13	do.	Human blood.

All the positive reactions occurred within five minutes. The anti-serum reached with $\frac{1}{1000}$ dilution of its antigen in three minutes.

Uhlenhuth[3] failed to obtain reaction with old Egyptian mummies, but with mummies of 66 years and under he was successful in every case.

The general results were as follows. Of 107 specimens of earth, cow-dung, stones and grass examined 72 were found to contain blood, and of these in 44 the blood was

proved by means of the precipitin reaction to be of human origin.

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Reviews of Books.

Wound Infection. By Col. Sir ALMROTH E. WRIGHT, M.D., F.R.S. Pp. 96. University of London Press Ltd. 1915. Price 2s. 6d.

This little book is not the latest pronouncement of Sir Almroth Wright on this subject—that was an address at the Royal Society of Medicine in the autumn, which has since been published in the medical journals [1]—but it is an address given at the same place earlier in the year. The author has done a great deal of most interesting work in studying the pathology of wound infection and Nature's resistance to it at his laboratory at Boulogne, and the account he gives in this book of his experiments and observations with regard to the emigration of leucocytes is of much interest; but since this little book of Sir A. Wright was published his deductions from these experiments, and his views as to the method by which the application of saline to a wound causes an increased flow of lymph, and the value of the lymph as an agent for the destruction of micro-organisms, have been adversely criticised by Sir Watson Cheyne in his *British Journal of Surgery* for January, 1916, and by Dr. Parry Morgan in a paper read before the Pathological Section of the Royal Society of Medicine (*Proceedings Royal Society of Medicine*, 1916, vol. ix. Path. Section). Dr. Parry Morgan was a worker at Sir A. Wright's laboratory at Boulogne. Sir Almroth Wright's deductions have also been criticised by Dr. Kenneth Taylor in the *British Medical Journal* for Sept. 2nd, 1916, in a paper on "The Mechanism of Saline Dressings."

[1] Since this review was written, another paper has been published in the journals on June 3rd, but it is only a summary of the treatment he recommends for gunshot wounds.

We strongly dissent from his teaching with regard to the uselessness of antiseptics. Let us examine the grounds on which he maintains they are useless. He admits that antiseptics are useful in the compound fractures of civil life because " here the microbes lie exposed on the external surface of the bone which has been thrust through the skin," but not in gunshot wounds, in which he says " they have been carried down deep into the tissues and lie on the inner face of a torn and ragged track, and that track is blocked by blood-clot and hernia of muscles." Now the description he gives of a gunshot wound is really the condition we have to deal with when we disinfect many compound fractures in civil life. It is not simply a protruding bone we have to disinfect, but extensive laceration within the limb. Yet in many cases, by the thorough cleansing of the wound and the application of a strong antiseptic, we are able to sterilise such a wound in civil practice. We are quite ready to admit that some very extensive and tortuous gunshot wounds may be most difficult to sterilise, but we cannot accept Sir Almroth Wright's description of the ease with which the compound fractures of civil life can be sterilised.

The next objection raised by the author to the value of antiseptics is that the pus in the wound will greatly hinder their action. But the chief use of antiseptics is to sterilise the wound before pus is formed. We know that serum—which Sir A. Wright says has less " quenching effect " on the antiseptic than pus—acts chemically on most antiseptics, so as to considerably reduce their power. But it is only a question of the use of an abundant quantity, and of prolonged application. The author then asks the question : " Is there any reasonable prospect of sterilising the wound by an application of antiseptics ? " In his answer he considers only suppurating wounds. But as we have just pointed out, it is to prevent suppuration occurring that an antiseptic is of the greatest value. He says antiseptics cannot reach the organisms in the granulation of the wound. But it should be our object to apply the antiseptic most thoroughly to the wound before the organism has penetrated its wall, and before granulation tissue is found, and the experiments related by Sir Watson Cheyne in his paper in the *British Journal of Surgery* (*ibid.*) seems to prove that antiseptics do penetrate the living tissues. Moreover, Carrel says that by the prolonged use of the hypochite of soda he can sterilise suppurating wounds.

Now, although Sir Almroth Wright tries to show what useless things antiseptics are, yet curiously enough he says that they have value in preventing the spread of infection from one septic wound to another, and therein he considers lies their whole value. But of their value for this purpose, used as a douche to the wound, we are very doubtful. The

washing out of a septic wound with an antiseptic, which is the method by which he considers it has prevented infection spreading to other wounds, seems to us a futile proceeding. What is really required to prevent the spread of infection is the boiling of all instruments, the wearing of sterilised rubber gloves, and the sterilising, by boiling if possible, of all bowls.

The author wonders why the " obvious non-success of the antiseptic treatment is not generally appreciated." We hope since this was written he has made some observations as to the great success of the antiseptic treatment in the hands of Dr. Alexis Carrel, in preventing wound infections among the recently-wounded French soldiers, and has noticed how well wounds already suppurating have progressed under antiseptic treatment in the hands of many surgeons. What can he show as the result of his " physiological " methods ? Can he induce Nature to sterilise a badly-infected wound, however freely lymph is poured out ? If the " non-success of the antiseptic treatment is not generally appreciated," the non-success of the " physiological " ought to be. His experiments with regard to emigration of leucocytes, and the action of pus on antiseptics, are no doubt very interesting, but his determined opposition to the use of antiseptics has retarded, not advanced progress, in dealing with the wounds of war.

Sir Almroth Wright proposes to treat infected wounds with vaccines. This does not seem reasonable. The wound is already swarming with organisms, and if their presence there cannot induce such chemical changes in the serum as will lead to the production of immunity, how can he expect a comparatively small number of dead organisms injected into the tissue to do so ? If the chemical products of the organism in the wound cannot reach the blood, as the vaccine can, then how can the products of the action of the vaccine reach the tissues in which the microbes lie, so as to produce a defensive action in those tissues ? But a truly prophylactic use of the vaccines, as in typhoid fever—*i.e.*, before the infliction of the wound—might be a great help in preventing infection, or in reducing its virulence, and, as has been suggested by Sir Watson Cheyne, this might be carried out during the training of the recruit.

In his epilogue the author makes a very remarkable suggestion. It is no less than a recommendation that those who treat the wounded should do so not as they think best, but on lines laid down by some authority, acting on the advice of a committee of Physicians, Surgeons and Pathologists. The idea of treating patients as a machine would, is so startling that it almost takes one's breath away. Suppose the treatment forced on the military practitioner by the authority turned out to be a mistake, and it was found to have been unreasonable

and unsuccessful in the light of further investigation and experience, would it be considered an infringement of military discipline to criticise it? If the author converted all the members of the committee to his view, and the authority laid it down that all antiseptics were to be put down the drain, and all wounds alone treated by the "physiological" method, would the remarks made in this review be regarded as a heresy demanding stern measures of suppression?

Surgical Diseases and Injuries of the Genito-Urinary Organs. By J. W. THOMSON WALKER, M.B., C.M. Edin., F.R.C.S. Eng. Pp. xviii., 879. London: Cassell & Company Ltd. 1914. Price 25s. net.

The diseases and injuries of the genito-urinary organs are here described in a thorough and lucid manner by one who is obviously a master of the subject. The author's personal experiences in dealing with the treatment of these diseases, which has been large, is freely drawn upon, and the opinions expressed and advice given bear the impress of being solidly based upon carefully-considered facts. The illustrations are excellent and numerous, and the coloured drawings of cystoscopic appearances are specially beautiful and illuminating. The book is likely to be the standard one on genito-urinary diseases in this country for many years to come.

Oxford War Primers. London: Henry Frowde & Hodder and Stoughton. 1915.

A very useful purpose is subserved by the timely publication of these handy primers, any two of which can be readily carried in the officer's uniform pocket.

Wounds in War, by Lieut.-Col. D'Arcy Power (pp. 108), the first we turn to, reminds us on the first page that the effect of the present war has been to throw us back to the time before Lister, when most wounds suppurated, for the wounds to be treated are already for the most part deeply infected before there is any possibility of treating them. "Some few things have had to be unlearnt. We know, for instance, why our forefathers made such large and deep incisions, why they amputated so freely, and why they preferred simple circular amputations to the more elaborate, and, as it seemed to us, the better method of cutting flaps. We know, too, why they valued a sound knowledge of the gross anatomy of arteries and nerves, laying very little stress upon the smaller details, whilst their

preference for poultices and wet dressings has been justified." Such a paragraph as we quote is of comfort, not for itself, but for what it implies, viz. that we must be prepared to revise our ideas in dealing with the wounded on the modern battle-field, and throughout these text-books we find that the experiences of those who in their several departments have more than justified the enterprise of the publishers. Much of the space of the particular volume we now have before us is devoted to practical if elementary surgical points, such as the ligation of various arteries which, while not usually coming under treatment in civil practice, may require immediate ligation in the trenches. But the sections on the preparation of vaccines, their uses, and the employment of sensitised vaccines, show that the work is thoroughly modern.

Medical Hints, by Colonel J. Edward Squire, is full of useful notes, though why tonsillitis should be included in this volume it is not easy to guess. We see that the author suggests atropine for the bronchitis of chlorine gassing.

Cerebro-Spinal Fever, by Thomas J. Horder, epitomises current knowledge of the disease. The author rightly emphasises the importance of following no rule of thumb method of administering Flexner's serum, but of pushing it in the super-acute types.

Nerve Injuries and Shock, by Captain Wilfred Harris, is approached mainly from the physician's standpoint. It contains a very useful chapter on nervous shock.

Wounds of the Thorax in War, by J. Keogh Murphy, *Injuries to Joints*, by Major Robert Jones, and *Abdominal Injuries*, by Professor Rutherford Morison and Lieut.-Col. W. G. Richardson, are in each case excellent.

Gunshot Injuries of Bones, by Captain E. W. Hey Groves, is one of the most original of the series. The author's extensive contributions to the furtherance of methods of fracture treatment have proved of great practical value in the treatment of bone injuries in war. Many useful suggestions will be found in the section on " Bone Grafts."

Surgery of the Head, by Major Bathe Rawling, and *Injuries of the Eyes, Nose, Throat and Ears*, by Major Andrew Maitland Ramsay, Major Dundas Grant, Captain Lawson Whale and Captain C. Ernest West, complete the series.

The latter volume contains short notes of some very interesting illustrative cases, and among them a case showing the value of tracheoscopy and bronchoscopy in diagnosing the exact nature of certain chest injuries.

While the standard of excellence reached in some volumes is perhaps higher than others, we have felt it unnecessary and even difficult to indicate this difference in any way, for every

volume is of very great value. The type is clear, the illustrations are all good, and the copious index to each volume adds greatly to the facility of ready reference to any point on which information is desired.

Encyclopædia Medica. Second Edition. Vol. III., Chloroform to Dyspnœa. Pp. 672. Edinburgh and London: W. Green & Son. 1916. Price 20s.—Another volume of "Green," the larger articles of which have been written and now revised by some forty contributing authorities in their respective subjects, under the general editorship of Dr. J. W. Ballantyne, who is the author of four of the major articles, is before us. The first article, on chloroform, commences with an historical introduction by the late Sir Alexander R. Simpson, and we note that the author, Dr. McAllum, calls attention to the fallacies of the corneal reflex, the common method being useless as a test of surgical anæsthesia. The well-known excellence of the articles in this encyclopædia is well maintained, but a detailed review of each volume is unnecessary.

Modern Medicine and some Modern Remedies. By THOMAS BODLEY SCOTT. Pp. xi., 159. London: H. K. Lewis. 1916.—These practical notes for the general practitioner are published with a preface by Sir Lauder Brunton, Bart., F.R.S., who writes that "it is a most welcome occurrence when a man fully qualified to do so writes down the ripe experiences of his life so as to help his fellow-workers, both general practitioners and consultants, who one and all may learn from him." The author apologises for "this *horæ subsecivæ* of a busy doctor whose ideas are not many, nor are they consecutive," but he is an experienced physician with special privileges, having a son who is an expert in bacteriology and the manufacture of vaccines, whilst the father ponders over and speculates on the results. In Chapter iii., "Therapeutic Speculations and Doubts," he gives a résumé of our present-day knowledge of ductless gland therapeutics, and makes many practical suggestions on their inter-association and possible uses. Much is being learnt on these endocrine organs, and the knowledge obtained is producing most important results, which have not yet come into general therapeutic use, but "with this new knowledge of the *vis medicatrix*, of its mechanism and of its chemistry, we must realise that our control over disease is enormously increased, and that there is a far brighter and less suffering future for the sons of men." Many useful suggestions are given in Chapter i., which is an excellent summary of all recent knowledge in "Disorders of the Heart," a chapter which requires to be read and pondered over before we can assimilate its valuable lessons. It serves to concentrate

most of the more modern knowledge of heart affections into more practical and useful methods of management and therapeutics. The same remark applies to the chapter on "Arterio-sclerosis," and the final one on "Chronic Bronchitis and Bronchial Asthma," for both of which the practice of organic therapeutics seems likely to do much good.

Index-Catalogue of the Library of the Surgeon-General's Office, United States Army. Second Series. Vol. XX. V.—Water Works. Pp. 595. Washington: Government Printing Office. 1915.—The present volume is smaller than its predecessors, yet it includes 4,566 author titles, representing 2,263 volumes and 3,517 pamphlets, and also contains 4,151 subject titles of separate books and pamphlets, and 22,977 titles of articles in periodicals. The subjects of "Water" and "Waters" occupy no less than 164 pages of closely-written references. It is a perennial pleasure for us to record our high appreciation of the labours of those concerned in the compilation of this most indispensable work.

The Medical Annual, 1916. Bristol: John Wright & Sons Ltd.—The thirty-fourth volume of this Year-Book of Treatment and Practitioner's Index has contributions from twenty-eight contributors, and maintains its usual characters, with the addition of much new matter relating to questions of naval and military surgery. Deputy Surg.-General A. Gascoign Wildey, R.N., gives much valuable information in a general review on "The Medical Officer and the Fighting-man," and Dr. A. C. Inman gives some twenty-five pages on "Wound Infections, their Bacteriology, Biology and Treatment." The editors express their deep regret that, after eight years of collaboration in the production of the *Annual*, they can no longer obtain the assistance of the late Sir Charles Bent Ball, Bart. The special injuries to organs and nerves are considered under their proper headings in the body of the work, and it will be seen that great changes of views have taken place, especially in regard to the surgical treatment of wounds.

In a note by Dr. Graham Little on Ringworm we find that the condition long known by Hebra's name, Eczema Marginatum, or Eczematoid Ringworm, has been differentiated by Sabouraud from the parasites of ringworm by cultural characteristics, and by the clinical observation that this parasite never attacks the hair. The fungus is found solely in the superficial layer of the epidermis, and Sabouraud called it the Epidermophyton Inguinale. It may usually be successfully treated by Whitfield's Ointment, containing 3 per cent. of salicylic acid and 5 per cent. of benzoic acid. In more obstinate cases a chrysarobin ointment, although somewhat irritating, is more effective, but it is of importance that the clothing which may have come into contact with the disease should be thoroughly disinfected.

Editorial Notes.

Our Second War Number.

THIS issue is our second enlarged and special number, and may be correctly described as a War number, inasmuch as all the original articles have special reference to the War, and, with one exception, by writers who deal with their work in military hospitals at home or abroad. Dr. William Gordon, of Exeter, who is to be congratulated on his re-appointment as President of the Balneological Section of the Royal Society of Medicine, went to Paris and made himself conversant with the valuable work initiated and developed at the Grand Palais Hospital in Paris. We are indebted to him for the results of his personal investigations and observations incorporated in his article in this issue.

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COLONEL H. L. NORRINGTON, R.A.M.C., has been awarded the D.S.O., a distinction on which the old friends, colleagues and fellow-students of his *Alma Mater* offer him cordial congratulations.

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Captain Orr-Ewing.

To Captain H. J. Orr-Ewing we offer hearty congratulations on his receiving the Military Cross for good work at the front in France. He is now engaged in one of the French General Hospitals.

MEETINGS OF SOCIETIES.

Bristol Medico-Chirurgical Society.

May 10th, 1916.

Major GEORGE PARKER, President, in the Chair.

Captain J. M. FORTESCUE-BRICKDALE read **Notes on the Enteric Group of Diseases as seen in an Isolation Hospital in France.** (See p. 73.)

Captain E. W. HEY GROVES read a paper entitled **Brains, Bones and Blood-vessels,** being Notes on some Surgical Experiences in the Near-East during the present War.

CAPTAIN E. B. HARTNELL.

Obituary.

CAPTAIN E. B. HARTNELL.

We deeply regret to have to record the death at Cairo of Captain Edward Bush Hartnell, in his forty-ninth year, the result of dysentery with acute appendicitis, contracted while on active service. His father, the late Rev. Bedford Hartnell, was for many years a House Master at Clifton College, and for some time the Head Master of the Junior School there. Edward Hartnell entered the Bristol Medical School, and towards the end of his student career was at Guy's Hospital. He obtained the qualifications of M.R.C.S. and L.R.C.P. in 1892, and shortly afterwards became assistant to the late Dr. E. M. Grace, of Thornbury, with whom he was associated for four years. He married Dr. Grace's daughter Alice. Leaving Dr. Grace, he set up in practice in Bridgwater in 1908.

Edward Hartnell was a keen sportsman, and responded early to the call for practitioners to join the R.A.M.C., for on September 21st, 1914, within a month of the outbreak of hostilities, he became attached to the London Mounted Brigade Field Ambulance. He displayed aptitude and enthusiasm for his new work, and very shortly afterwards was raised to the rank of Captain. With a brief period of training at North Walsham, he sailed from Avonmouth for Egypt, and for a short time was placed in charge of the Anglo-American Hospital. Subsequently he was transferred to Gallipoli, where he saw a good many severe engagements, and performed valuable work for the wounded there. In December, 1915, he returned to Egypt, and after working in various camps, he proceeded to the Suez Canal, where he remained until he was attacked by dysentery, and transferred to the Nazrich Hospital, Cairo. Here appendicitis developed, and, weakened by his previous illness, he succumbed on April 25th.

Edward Hartnell had earned the warm regard of his colleagues at Bridgwater, and was held in very high esteem by his many patients and friends there, by whom the loss of so sure and good a friend is as sincerely mourned as amongst his old associates and his teachers and fellow-students at Bristol and Guy's.

We quote a short abstract from the reference made by the Vicar of St. Mary's, Bridgwater, the Rev. J. J. Langham, at the service following news of his death :—

" By the death of Captain E. B. Hartnell, while engaged in

the service of his country, this church and parish has lost a loyal and devoted worker. It was indeed with a distinct sense of loss that we heard that at the beginning of the war he had obeyed the call of King and Country. We wondered how we should get on without him, and were looking forward to the time when he would be able to return at the end of the war and resume his activities. But God has willed it otherwise, and has called him to the higher service in Paradise. Meanwhile he has left behind him a rich legacy of example—the example of a life of devoted service to his God and his church.

"We pray that God will give us grace so to follow his good example, that, with him, we may be partakers of God's heavenly kingdom."

Captain Hartnell leaves a widow, one daughter aged 12, and a son aged 9. To them we extend our deepest sympathy.

ALFRED GRACE, M.R.C.S., L.S.A.

WITH very sincere regret we have to record the deaths of the last two sons of the late Dr. Henry Mills Grace, of Downend, which have taken place during the last year. All five of the sons entered the profession at the Bristol Medical School, and all came well to the front in one or other of the fields of sport, at least three of them establishing records that will last for many years to come. The remarkable energy that pervaded the whole family enabled them not only to attend to their professional duties, but to find time to indulge to the full and to excel in any of the manly sports that they individually took up.

Alfred Grace, of Chipping Sodbury, was the second son, and was born in May, 1840. After attaining man's estate he qualified M.R.C.S. and L.S.A. in 1863 and 1864, and then acted as House Surgeon at the Bristol Royal Infirmary for six months.

In 1865 he went to Chipping Sodbury, taking the practice of the late Dr. Brookman, and was appointed Medical Officer to the Union and Public Vaccinator, which post he held till he resigned at the age of 65. He succeeded his father as Surgeon to the Royal Gloucestershire Hussars, and rose to the rank of Lieut.-Colonel. He was Certifying Factory Surgeon for the district and Deputy Coroner for the Lower Division of Gloucestershire Medical Officer to the Coalpit Heath Collieries (this post, now held by Mr. A. H. Grace, has been held by one of the family for eighty years), and he was doctor to the Oddfellows, Foresters, and many other clubs.

Some years ago he wrote an article in the British Medical

Journal, advocating large doses of morphia hypodermically in cases of eclampsia, which drew forth considerable correspondence in the medical journals of the time, and he was a man of sound judgment and dexterity in the many surgical cases that fell to his lot.

With all these appointments, an extensive family practice (his books averaged for years one hundred and fifty confinements per annum), and a large county connection among friends that he met in the hunting-field, it is marvellous that he was able to get through all that he did.

He was a good boxer, and quite a good cricketer, though he never rose to the eminence that his brothers enjoyed in that game. But if he did not take as high a place in cricket, he was about as good a rider to hounds as his brother W. G. was a cricketer. Many historic runs he took part in, and he once on an Irish thoroughbred cleared a stream near Littleton-on-Severn thirty feet from bank to bank. For thirty years he never bought a hunter, these being given him by various hunting friends, sometimes as unmanageable, but more often by admirers of his prowess in the saddle. He is frequently referred to by Whyte Melville and other hunting authors, in one place as the hunting doctor, worthy brother of the great W. G.

He was a man of retentive memory, and with his large experience of life and people in every grade of society, his practical knowledge of sport, and his keen appreciation of everything that makes life worth living, he was a most interesting companion, and his loss is felt by a large circle of friends.

DR. W. G. GRACE.

Of William Gilbert Grace, whose death took place in October last, much has been written during his life, and more would have been written at his death if it had occurred at any other time than the present. He was born July 18th, 1848, entered the Medical School in 1868, and qualified M.R.C.S. and L.R.C.P. in 1879, taking rather a long time between his "primary" and "pass." The writer of this memoir well remembers sitting next to the great man at the examination at the College of Surgeons, when both successfully went in for their primary.

W. G. settled in Stapleton Road, and was Medical Officer to No. 2 District Barton Regis Union from 1879 to 1898, also Medical Examiner for the Prudential Society and during the time that he lived in Bristol and afterwards in Victoria Square,

Clifton, did a considerable amount of medical work, especially in the winter months.

One incident may be mentioned to show that W. G. was not merely a cricketer. When the writer was Surgeon for the week at the Bristol Royal Infirmary five men were admitted one morning all badly burnt in an explosion at a colliery to which W. G. was medical officer. They asked for him, and he called in to see how they were. Although they were much covered by wool dressings, when he came he knew them all by name, and his words of sympathy comforted them not a little.

His cricket career has been treated of elsewhere; suffice it to say that his pre-eminence has never been challenged. He left Clifton in 1899 and lived at Sydenham. Here he played some cricket, and was often seen running with the beagles; and he played a good deal of bowls and was very fond of shooting, being a good shot. After giving up more active sports he went to reside near Eltham, where his garden gave him the greatest enjoyment.

Coming before the public eye as much as he did during at least thirty-five years of his life, through all the summer every school-boy and nearly everybody else looking into the papers to see what W. G. had done, it is remarkable that he was such an unaffected and simple-minded man. In private life he was a most affectionate husband, father, and friend, and he leaves a void that none can fill.

He lost his only daughter, Bessie, when she was twenty years old, just as he was leaving Clifton, and a few years later young W. G., a master at the Royal Naval College at Osborne, and ex-captain of the Clifton College Eleven, died of appendicitis; and there are left his widow and two sons, Edgar, Captain of H.M.S. Grafton (he was at the Dardanelles at the time of his father's death, and he himself has a son a midshipman just going to sea), and C. B. Grace, Major in the Kent Fortress Engineers.

A. W. P.